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Foreign telecom vendors dial up U.S. sales

Bar codes: Keeping track in the factory

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200

The top 200 U.S. electronics corporations

Electronic Business

VOL. 13, NO. 14 JULY 15, 1987

THE BUSINESS MAGAZINE FOR THE ELECTRONICS INDUSTRY

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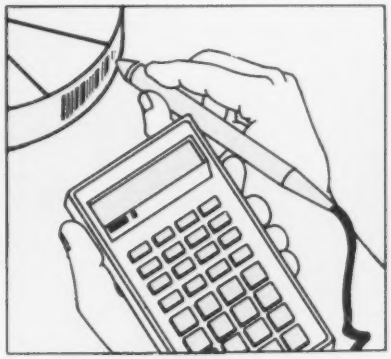

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Communication equipment production picked up

AT&T gets control of its costs. Now, will the company benefit from the market's growth?

According to the Electronic Industries Association, U.S. factory sales of communication equipment in the first quarter of 1987 added up to $16.3 billion, an increase of 4% over the same quarter of last year. Judging by the much smaller growth that the U.S. Department of Commerce reports in industrial production of such equipment in the United States — only 1% for the same quarter — most of the increase must have come from sales of imported equipment.

AT&T, the largest domestic company in this market, offers a good example of the situation. All of its manufacturing is in the United States; therefore, it sees little of the market's growth. Indeed, the company's revenue went down in the first quarter by almost 7%. Net income went up 26%, "somewhat better than we expected," according to chairman James E. Olson, thanks to the cost reductions that began last year. But a major part of those reductions consisted of paring the workforce last year by 6% — more than 20,000 employees.

The EIA forecasts that U.S. sales of communication equipment will grow 4.5% this year. However, the association's previous forecasts underestimated the strength of this market in the U.S. in the past two years. The EIA had forecast the growth of the market for 1985 at half of the 18% it achieved, and predicted a decline of 2% for 1986, a year that sales increased by 13%. But, as it happened in the first quarter of 1987, it was foreign equipment that benefited from that growth. Industrial production of communication equipment in the United States grew by 8% in 1985 and stayed even in 1986. For 1987, Cahners Economics forecasts that production will grow 3%.

Then, there is the yen. At a remarkable strength of 140 yen to the dollar, 30% higher than last year, it would seem to make it very difficult for Japanese imports to reach the U.S. market. But, unless there is outright intervention of the U.S. government to bar imports of Japanese communication equipment, their penetration of the U.S. market may continue. Japanese communication manufacturers have emulated their automobile counterparts by estimating their production costs at 180 yen per dollar, even when it was over 200 yen per dollar. This has allowed them to absorb a major portion of the yen's increase in strength. But there is more.

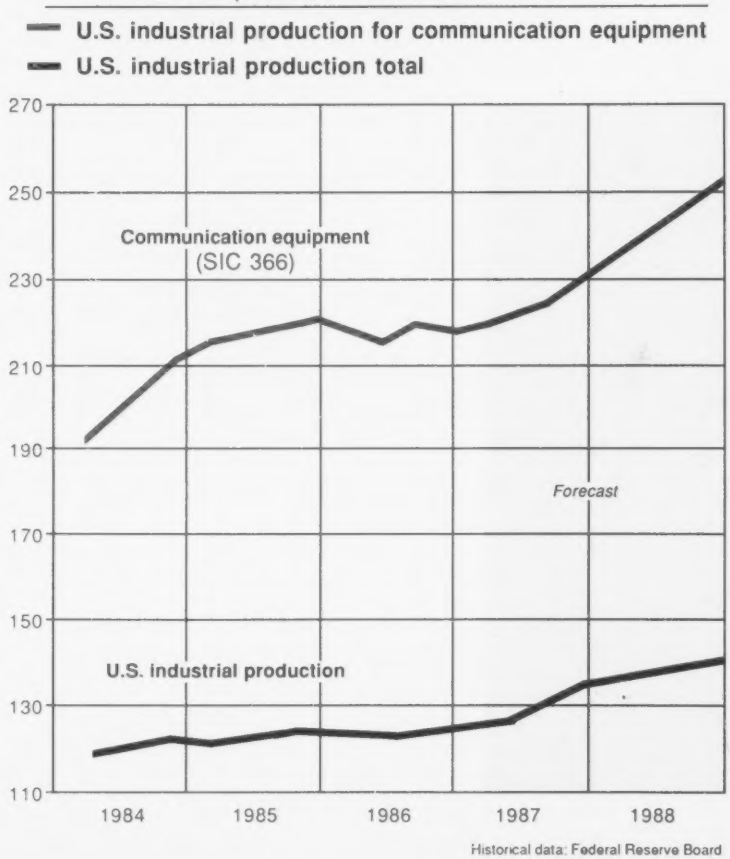
"While their major weapon in the past was price, today it is features. At the same time, Japanese companies are bringing in to the United States telephone products for the consumer, which incorporate many features that the more affluent consumers have learned to appreciate at their business offices and are eager to buy for their own homes.

For 1988, Cahners Economics forecasts 9% increase in domestic production. If U.S. manufacturers can get to market at the same time as the importers do with their features, the Cahners forecast may turn out to be conservative.

ALBERTO SOCOLOVSKY

Communication equipment

Industrial production indexes, 1977 = 100



Historical data: Federal Reserve Board
Forecast: Cahners Economics

Electronic components

Price trends within the electronic component market were somewhat mixed during the first quarter of 1987. In several product categories, including connectors and resistors, prices edged upward; in others, such as capacitors and some types of semiconductors, they dropped slightly. Industry-wide, prices decreased 0.2% in the first quarter, following an increase of 1.8% for all of 1986. Over the course of this year, as the business recovery gains steam and the U.S. rate of inflation picks up, manufacturers will gradually begin to raise prices. Prices are expected to climb 2.5% this year and 3.5% next year.

Capacitors

Capacitor prices dropped sharply in early 1987, after climbing for three consecutive quarters. In the first quarter, they averaged 1.8% lower than they did during the last quarter of 1986 and 1.3% below the year-earlier level. Mild upward price pressures are expected to resume during the rest of 1987, as demand increases from manufacturers of computers and other types of electronic-based equipment. Capacitor prices are expected to climb 0.8% this year and then post a further increase of 3.3% next year.

Connectors

Connector prices rose 1.8% in the first quarter of 1987, the biggest quarter-to-quarter spurt during the past two years. Over this period of time, manufacturers have felt the pressure of rising material costs, and prices have advanced continually each quarter at an increasing rate. In the next 12 months, as price competition from foreign suppliers eases off and the underlying rate of U.S. inflation pushes upward, the rise in prices is likely to accelerate. After climbing 3.5% in 1986, prices are forecast to jump 6.2% this year and 6.8% in 1988.

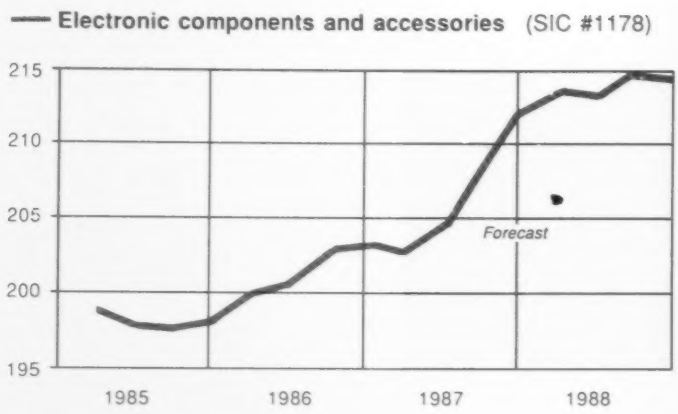
Resistors

Following three quarters of almost no increase in price, manufacturers of resistors started off the year by raising prices an average of 0.9% in the first quarter. The move was triggered by a sharp increase in orders during the period and by expectations of further steady improvements in demand from end users during mid-to-late 1987. After the first quarter's fairly substantial boost, prices are expected to rise at a less rapid pace through year-end, increasing only 1.1% annually. A more modest advance of 0.2% is expected next year.

Producer price indexes

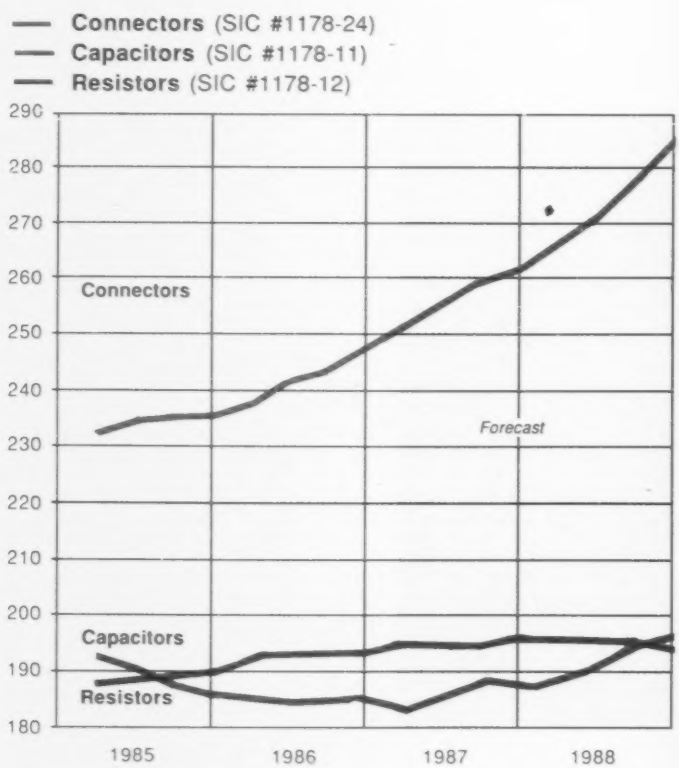
Electronic components

December 1967 = 100, quarterly averages



Passive components

December 1967 = 100, quarterly averages



Historical data: Bureau of Labor Statistics
Forecast: Cahners Economics

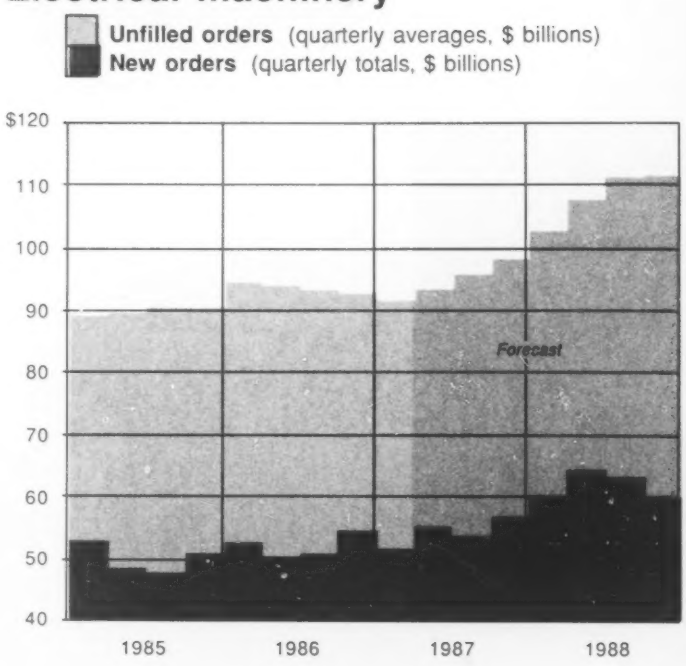
Electrical machinery

New orders
Manufacturers of electrical machinery received $51.6 billion in new orders during the first quarter, a moderate decline from the fourth quarter's $54.4 billion figure and 1.8% below the year-ago quarter. This sluggishness was related almost entirely to a falloff in military procurement of communication equipment. All other segments were up from year-ago levels. The most substantial growth was for household appliances and lighting equipment; each up more than 15%. More modest gains were reported for electronic components, consumer goods and electrical apparatus. In light of the mixed performances, overall order growth should be a modest 4.8% this year and 14% more in 1988.

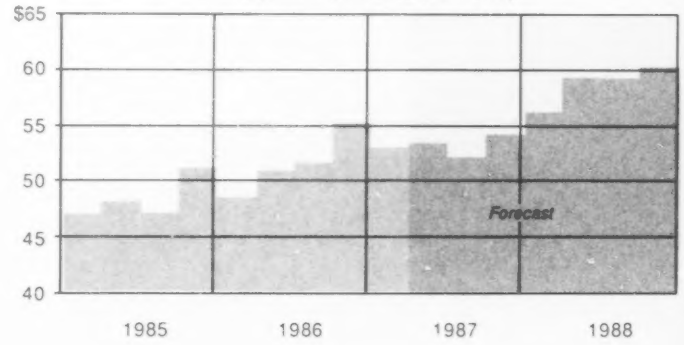
Unfilled orders
Last year's industrial sector decline and a cooling off in the defense boom have caused order growth in the electrical machinery market to slow markedly over the past 12 to 18 months. These developments have forced manufacturers to work down their order backlogs over the past several quarters in order to bolster production and revenue. By the end of the first quarter, unfilled orders fell to $91.26 billion, down from $94.31 billion in last year's first quarter. With nondefense orders now beginning to turn around, backlogs are expected to rise gradually over the balance of 1987.

Shipments
First-quarter shipments of electrical machinery amounted to $52.9 billion, an increase of 8.9% over the year-ago level. Growth was paced by the appliance and lighting equipment markets, where order activity has been unexpectedly strong in recent months. The electronic component and communication equipment segments grew only moderately, while electrical industrial apparatus, and TVs and radios barely outpaced a year ago. The recent slackening in defense orders is expected to restrain overall market growth, offsetting much of the improvement that is occurring elsewhere. This will hold 1987 shipments to $212.1 billion, a gain of 31%.

Inventory-to-shipment ratio
Between August 1986 and March 1987, electrical machinery manufacturers cut their inventories by nearly $640 million. This cost-cutting measure came hand in hand with slow but steady expansion in shipments. As a result, the level of industry inventories relative to shipments decreased slightly. The I/S ratio for this year's first quarter was 2.19, about even with the prior quarter but well below the peak of 2.50 in the spring of 1985. Manufacturers are expected to maintain tight control over inventories throughout the early stages of this expansion, keeping the ratio in a narrow target range of 2.15 to 2.20.



Electrical machinery: Shipments
(quarterly totals, $ billions)



Electrical machinery: Inventory-to-shipment ratio
(seasonally adjusted, quarterly averages)

Historical data: U.S. Department of Commerce
Forecast: Cahners Economics

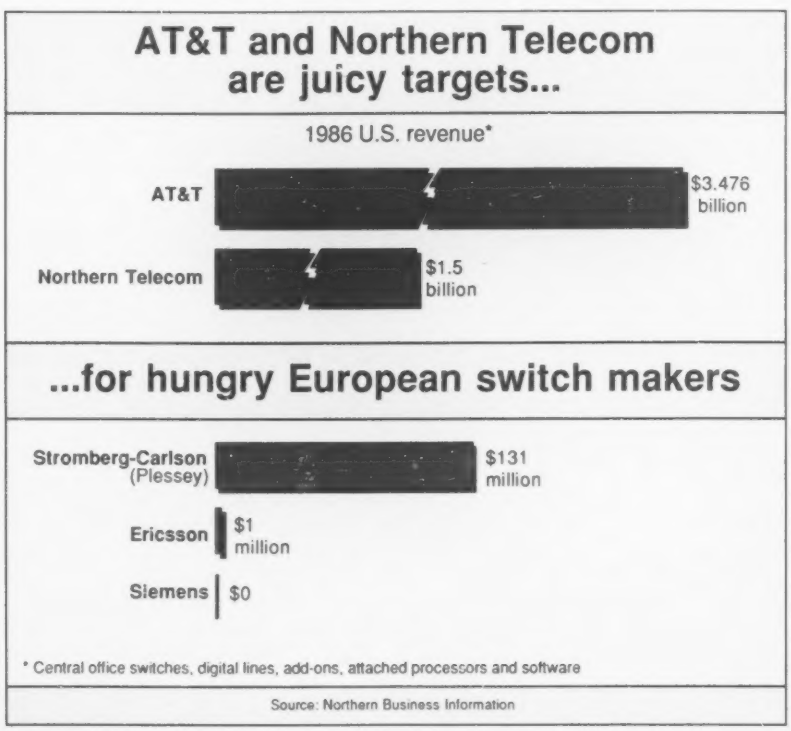
Taking on AT&T and Northern Telecom

Heirs to divestiture, Ericsson, Plessey and Siemens are starting to make inroads in the U.S. market

Somewhere between monopoly and oligopoly lies the domain of duopoly: the domination of a business by two sellers. The breakup of AT&T, along with the emergence of Northern Telecom, has left the central office switch market with two overwhelmingly dominant vendors accounting for close to 90% of all sales. Nobody is saying that this is a rigged market. But switch customers, chiefly the divested regional Bell operating companies (RBOCs) are determined that it never gets to that point.

To realize the benefits of greater price competition and to gain greater autonomy over software development, the RBOCs are encouraging the emergence of alternative switch suppliers. Chief beneficiaries of this customer revolt are a group of European vendors determined to unlock the U.S. market. In recent months, U.S. West, Bell South and Ameritech have awarded major switch contracts to Ericsson, Plessey and Siemens over their powerfully entrenched rivals. Further market-cracking awards are likely since six of the seven regional telephone giants are either testing or installing Class 5 central office switches from the Europeans.

"We think the price will be lower in a highly competitive market," Randall Corn of Bell South Services explains. "And with just two vendors — I would not describe that as highly competitive," adds Corn, who, as segment manager for fundamental network architecture, evaluates and purchases switching equipment for Bell South's operating companies.



"You've got two incumbents that have pretty much reached equilibrium in the marketplace," observes Van Cullens, vice president for marketing of Plessey Co.'s Stromberg-Carlson subsidiary. "I'm not implying at all that there would be any collusion," Cullens continues. "But I think it's the view of most of these [telephone operating] companies that at least three vendors are necessary to give you diversity of choice."

Stromberg-Carlson recently parlayed that desire for diversity into a 600,000-line order from Bell South valued by Cullens at "somewhere between $100 [million] and $200 million." Fifty-two central office switches handling 150,000 lines will be installed in rural areas of the South during the first year of the contract.

Another foreign-based duopoly-denter is Ericsson Network Switching Systems, a subsidiary of L.M. Ericsson of Sweden. U.S. West, in the process of converting from electromechanical switches to digital switches across the state of Idaho, recently awarded Ericsson a 50-switch contract over AT&T and other bidders. Anthony D. Costanzo, market development manager for Ericsson Network Systems, states that his firm's U.S. central office switch market-share objective is "12% to 15% by 1992." Then, perhaps still heady with the U.S. West victory, Costanzo quickly recalculates: "Well, by then we'd be at least 15%, probably more."

Last year, according to Prudential-Bache Securities Inc. and Dataquest Inc., the U.S. central office switch market was worth $3.1 billion. But this is a market that has begun to go the wrong way. This year, sales should sag to $2.9 million and in 1988 drop again, to $2.5 billion. Northern Business Information foresees the total number of digital local lines placed in service dropping from 10.5 million in 1986 to 8.1 million in 1989. With Ericsson, Siemens and Plessey (along with Japanese hopefuls like Fujitsu and NEC waiting in the wings) all desperate to recover multihundred million-dollar switch-development

Jon McIntosh

costs and prove their ability to compete in the world's toughest market, things are likely to get ugly for AT&T and Northern Telecom.

Stiff upper lip

But for now at least, upper lips are stiffening. Jerry Johnson, AT&T's manager, product planning, digital switching equipment, expects the market share of the new vendors to "grow a little, but not significantly."

Alan G. Lutz, vice president for group operations of Northern Telecom's Integrated Network Systems division, concedes that the telephone companies "have a strong desire for a third source." He traces this tendency to the burdensome presence of RBOC-progenitor and authority-figure AT&T: The RBOCs, he argues, don't like buying switches from AT&T Technologies while AT&T Communications competes with their telephone services.

Lutz concedes that there has been substantial price deflation in the increasingly competitive switch business, but he claims that Northern Telecom is the low-cost producer and most likely to survive if price wars erupt. And Lutz maintains that the new vendors may find themselves in unpleasantly cold waters after the thrill of their early splash wears off. For one thing, he warns, the need for heavy investment does not end with product development. "They will only come to recognize that as they have a little bit of early success," Lutz says. The infrastructure investment in installation, service, technical assistance and customer training could overwhelm some of the new entrants, according to Lutz. "What do you do when a bank calls a telephone company and says: 'I don't like the service anymore because it doesn't work.' And the phone company calls the supplier and says: 'You have two days to rectify that.' And you only have three people in the United States."

Like ants at a picnic, Ericsson, Plessey and Siemens are sneaking away with bits and pieces of Ma Bell's and Northern Telecom's market

But, meanwhile, Ericsson and Stromberg-Carlson have shrewdly identified unmet market needs to win their "little bit of early success." Early market research convinced Stromberg-Carlson executives that they could concentrate on rural and suburban areas served by lower capacity switches. Ninety-four percent of all telephone central offices (accounting for 72% of all lines) require switches servicing 25,000 lines or less. And AT&T's solutions in this market sector were expensive, according to Cullers. Stromberg-Carlson decided to promote a switch architecture consisting of a relatively large number of small networked hosts. The company is touting this approach as better suited to rural phone company needs than systems based on large and powerful, but remote, hosts. With Bell South, this pitch — along with bare bones pricing — clearly worked.

"It was cheap," allows Bell South's Randall Corn in explaining the choice of Stromberg-Carlson. Corn said the Stromberg-Carlson switches, which typically handle 2,000 lines or less, do not offer the sophisticated software of larger switches. But, he adds, there isn't much demand for sophisticated

business switch features in the rural areas of Alabama, Kentucky, Louisiana, Mississippi and Tennessee, which are the states that the Stromberg lines will service. Corn says that the Stromberg switches will fulfill less than half of Bell South's near-term switch replacement needs. In replacing some of its larger urban switches, Bell South would be unlikely to purchase the small Stromberg switches, Corn adds.

Software intensive

Price is not the only selling point for the duopoly-denters. The switch business, like the computer business, is becoming increasingly software intensive. And growing share of the switch revenue of AT&T and Northern come from software updates and new feature packages. But the telephone companies want greater independence in developing their own customized applications. Bell South's Corn, while emphasizing the sophistication of programming skills required to tweak central switch software, adds that software development "has been a problem with the established market participants."

Would-be market participants have zeroed in on the opportunity. "Both Siemens and Ericsson have offered the telcos greater control in software development," says Glenn Powers, senior analyst with Northern Business Information. This, says Powers, has appeal for AT&T and Northern customers that "have no control over the product and the way software upgrades are made." Sometimes, says Powers, customers wanting a specific upgrade find they must purchase prior upgrades as well. AT&T's Johnson says that this is true but describes the cost of basic software updates as relatively modest.

Ericsson's Costanzo says that his company is offering the operating companies support in developing their own customized applications. "We have extended offers to the operating companies for them to have their design people work side by side with our design people in the preparation of new enhancements . . . . We provide the source code when we sell the switch . . . . To my knowledge, Ericsson is the only one that has made the source code available and has offered the RBOCs the opportunity to participate in software development."

> The Europeans know that the tests they face in selling against AT&T and Northern in the U.S. will soon be reenacted in their home markets

But Northern and AT&T are both sensitive to this marketing tack and appear to be responding in kind. "Software control is a desirable function from our customers' standpoint," Northern's Lutz acknowledges, "because it puts them in stronger control of the evolution of their own business." He says Northern is addressing that desire by working together with customer programmers in developing new code for customized features.

Jerry Johnson, manager of product planning for digital switching equipment at AT&T, agrees that there has certainly been interest expressed by customers in developing their own applications. But, adds Johnson, there are some potential problems. If, for example, a customer writes its own code for customized features, what happens when AT&T issues one of its periodic systems software updates? What if the updates and the customer code don't work together? Who's responsible for insuring that they do? asks Johnson.

It appears that AT&T has the disadvantage of an incumbent here, trying to maintain software across a very broad customer base. Another interpretation of AT&T motives would be that it clearly enjoys the benefits (and profits) that issue from control of software development. In either event, it is not likely that AT&T and Northern, aware of customer desire for greater software development control, will allow Ericsson and others to win business on this point alone.

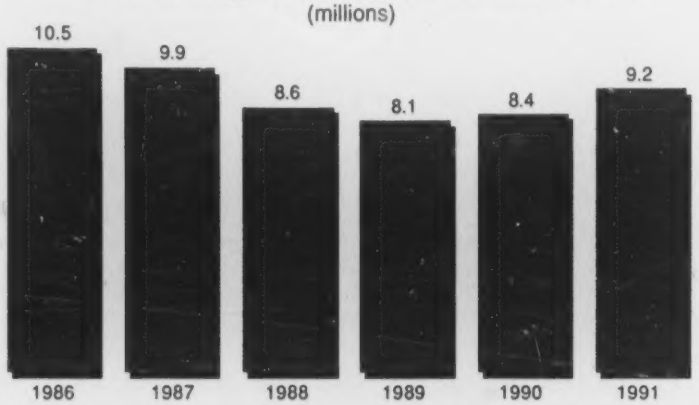
While AT&T and Northern Telecom face the unpleasant prospect of losing share in a shrinking market, the European companies are at substantial risk themselves. At a time when AT&T is aggressively trying to expand its own overseas switch sales; foreign telecommunications companies, which have long enjoyed the status of privileged government suppliers, are faced with the unfamiliar prospect of competition. The American telephone system is the biggest and the most sophisticated in the world, says Bell South's Corn. Siemens, Ericsson and Plessey are well aware that their home market hegemony is being challenged by the companies that have built that system. The Europeans know that the tests they face in selling against AT&T and Northern in the United States will soon be reenacted — for higher stakes — in the markets that they have monopolized, duopolized, oligopolized.

Meawhile, if the RBOCs have their way in the United States, duopoly will be averted. The regional phone giants would undoubtedly prefer to see an oligopsony. That is: a market where a small number of influential buyers call the shots.

NORM ALSTER

Telecommunications companies crowd into a sagging market

Total number of digital local lines placed in service in the U.S. (millions)



Source: Northern Business Information

Bar coding: Scanning a $1 billion business

Demand for industrial bar code equipment is driven by a need for efficiency. It's all part of the JIT/CIM evolution

By Bruce C.P. Rayner

The automatic identification market is riding high on the crest of the automation wave. Bar-coding systems, representing about 85% of the auto ID market, are gaining converts in industrial applications as more and more companies realize the cost and efficiency advantages. For the auto ID industry this means good pickings for at least the next five years, with most of the business coming from industrial applications.

According to Edward Ross, president of Ross Associates Inc., a Needham, Massachusetts-based market research firm, the total bar code market in 1986 was $511 million and is expected to grow to over $1 billion by 1990 at an annual rate of 19%. On the more optimistic side, Frost and Sullivan Inc., a New York City-based market research firm, estimates the 1986 bar code market at $750 million and anticipates a 30% annual growth rate through 1990 when the market will reach $2.3 billion.

In essence, there are three components of any bar code system: the label that is attached to the item that is being monitored; the reader or scanner that records the information on the label or tag and sends it to the computer database; and the printer that prints out the labels. Of the five or six primary bar code symbologies, the most widely accepted in the industrial market is Code 39.

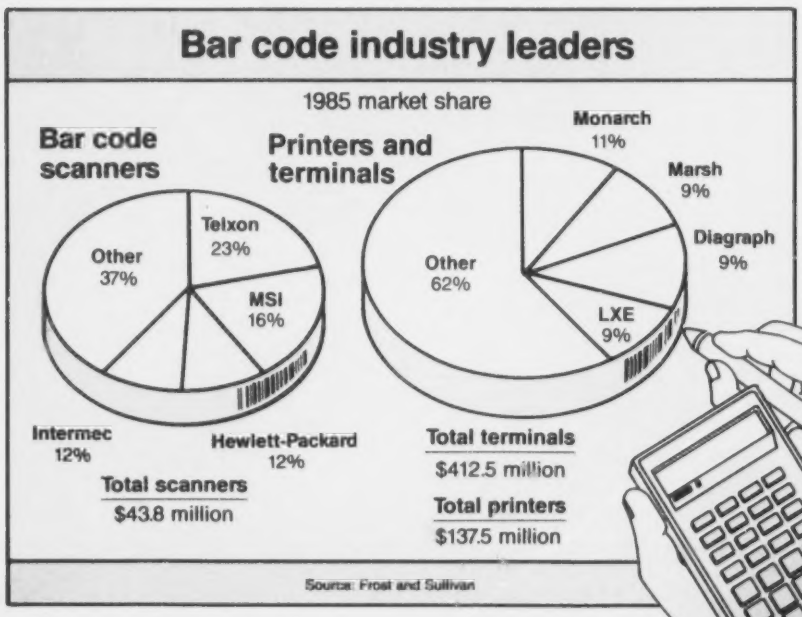
In some industries, unresolved standardization issues are preventing automation from taking off. Not so in bar coding. Although Code 39 is the de facto industry standard, most readers have the potential to "auto-discriminate" between a number of different symbologies.

To date, most of the demand for automatic ID systems has come from large corporations that feel the full effects of offshore competition. With the need to improve efficiency to remain competitive, many industry leaders, particularly in electronics, have incorporated bar-coding systems in their factories.

IBM's packaging line for electronic components in Research Triangle Park, N.C., is a good example of a highly automated packaging-inventory management system. As a part of this system, an automatic labeling system was installed at the facility by York Tape and Label Corp. of York, Pa., in 1985. Because of the success of the labeling system, IBM has just ordered a second system. IBM's facility incorporates robotics systems that automatically scan the bar-coded products before they are packaged. IBM will not comment on the financial advantages that the system provides.

Another example of a successful bar code system is in Tandem Computers Inc.'s printed circuit board facility in Watsonville, Calif. By using bar code license plates on the PCBs, Tandem has managed to reduce work-in-process cycle time from 20 weeks to less than two weeks, and quality acceptance has risen from 80% to 93%. Also, inventory levels have been cut nearly in half, from $17 million to $9 million.

Demand for bar code systems is starting to trickle down to smaller companies, too. This trend is partly because these companies are often forced to adopt bar coding because



they are suppliers to large original equipment manufacturers (OEMs). This is the case for the automotive and electronics industries, as well as for suppliers to the U.S. Department of Defense.

Even though a supplier's initial reaction to the bar-coding system may be negative, the end result is invariably positive. Estimates of the payback period for a bar code system range between eight months and 18 months. The savings from auto ID systems come mainly from improved inventory management, better work-in-process control and more accurate shipping and receiving records.

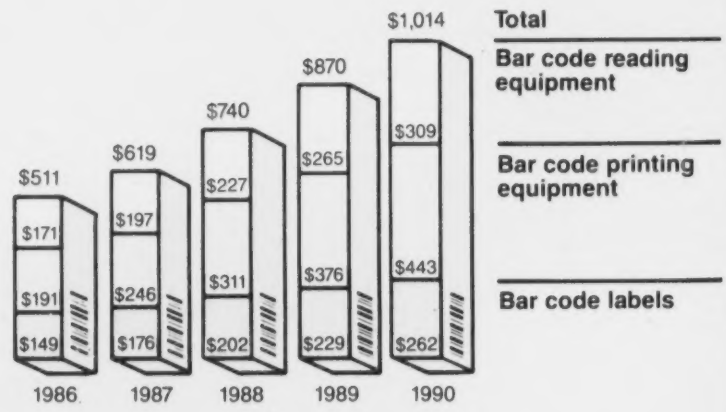
But, more important in the long term, auto ID systems are an integral component in the overall philosophies of computer-integrated manufacturing (CIM) and just-in-time manufacturing (JIT). Bar coding ties in with an existing material requirements planning or manufacturing resource planning system — MRP or MRP II — and enhances management information systems (MIS).

Edward Coe, a senior manager in auto ID systems with Deloitte, Haskins & Sells based in Detroit, sees the bar code industry moving more toward systems solutions that tie directly into an alphabet soup (JIT-MRP-MIS-CIM) environment. Bar coding, says Coe, is leading the way into a new era of information management in a more distributed and decentralized framework.

The key to success in the bar code industry, says Coe, is the ability for companies to "put it all together." Instead of marketing one line of hardware or one software package, the big winners in the industry will be those companies that can offer the systems solution to customers' problems. Some of the leading companies in the

The U.S. bar code industry

Worldwide shipments by U.S. companies ($ millions)



Source: Ross Associates Inc.

Shipments of bar code equipment and labels

Reading equipment ($ millions)

	1986	1987	1988	1989	1990
Wands	$11.5	$12.5	$14.0	$16.5	$20.0
Laser types					
Hand-held	23.0	34.5	48.0	65.0	85.0
Fixed	17.0	24.0	34.0	47.5	65.0
Slot (retail)	76.0	76.0	76.0	74.5	71.0
Read electronics	43.5	50.0	55.0	61.5	68.0
Total	**$171.0**	**$197.0**	**$227.0**	**$265.0**	**$309.0**

Printing equipment ($ millions)

	1986	1987	1988	1989	1990
Form printers*	$ 87	$106	$129	$158	$192
Label printers	104	140	182	218	251
Total	**$191**	**$246**	**$311**	**$376**	**$443**

* Dot-matrix-computer type

Bar code labels ($ millions)

	1986	1987	1988	1989	1990
Photocomposition	$ 23	$ 25	$ 28	$ 27	$ 27
Card-type labels	43	53	66	83	104
Industrial labels	68	82	90	99	110
Film masters	15	16	18	20	21
Total	**$149**	**$176**	**$202**	**$229**	**$262**

Source: Ross Associates Inc.

industry are following Coe's recommendation.

"Most people want to buy a solution, not equipment," says Roger Palmer, vice president for product and market development at Intermec Inc., a $62-million Lynnwood, Washington-based bar code company. Intermec manufactures readers, printers, and communications and network devices. "We see ourselves as the data-collection or automatic-identification experts," he says. The company also resells equipment of other vendors. Since the early part of the decade, Intermec has targeted the industrial marketplace because, says Palmer, it is the most lucrative.

Similarly, such players as NCR Corp. and Hewlett-Packard Co., although not solely in the bar code business, also offer turnkey bar-coding solutions. HP sold over $50 million worth of peripheral bar code equipment last year, not including software. With project centers around the country, HP acts as a prime contractor for bar-coding systems. NCR did about $30 million in shop-floor turnkey systems as a systems integrator in 1986, says Jerry Webb, program manager for manufacturing systems in the product marketing division for NCR. The company, however, does not manufacture its own bar code equipment.

But market researcher Ross questions the sensibility of companies that want to be all things to all customers. He points to the poor condition of one-time market leader Computer Identics Corp. (CI) of Canton, Mass., that prides itself on being a systems company. CI fell on hard times a few years back and has hovered around $10 million in sales ever since. Even progressive Intermec, Ross claims, gains little from trying to cover the whole spectrum of products.

Instead, Ross points to up-and-coming specialist companies, such as Symbol Technologies Inc., as the players with successful business acumen. Symbol Technologies, a Bohemia, New York-based maker of laser scanners, sells to both distributors and OEMs, like IBM and NCR. President Ray Martino believes that the handheld laser-scanner market is the fastest growing area in the industry. From $8.7 million sales in fiscal 1984 (ended July 30, 1984), Symbol Technologies expects to do $44.5 million in sales for fiscal 1987.

Two other well-managed and well-entrenched companies in the portable scanner market are Telxon Corp., located in Akron, Ohio; and MSI Data Corp., based in Costa Mesa, Calif. Both of them have been extremely successful in the marketplace, and both buy units from Symbol Technologies. Telxon's director of market research, Randall Veatch, says that the key to Telxon's success is its focus on vertical marketing. The $100 million company also does specialized systems that involve a high degree of customer service, he says.

Scanning change

When it comes to technological change, the bar-coding business is similar to other industries that are moving toward smaller, more powerful systems. The most significant implication that new technologies are having on the bar code industry is that they allow more distributed systems, higher accuracy and lower cost.

A good example of technological

Getting in the swim of things

Salmon are generally not known for their high-tech sophistication. That is, unless they are salmon that run in the Columbia and Snake rivers in the northwestern United States. In a project funded by the Bonneville Power Authority and conducted by the National Marine Fisheries Service, samples of smolts (young salmon) have been injected with radio frequency transponders — commonly called RF tags — in order to monitor their migration.

Since the project began in 1986, there has been nothing but rave reviews from everyone involved — including the salmon. Earl Prentice, fisheries research biologist with the NMFS, believes this pilot program has a bright future. There are no harmful effects on the fish and the equipment is working like a charm. "This is only the start of a very large program to use this tool," Prentice claims, confidently. He speculates that the application for RF tags in wildlife and marine tracking will be used all over the world in the near future.

RF tags are a spin-off from inventory monitoring technology used mainly in industrial applications such as warehousing and manufacturing. When the transponder attached to the item being tracked is activated by a transmitter, it sends off a unique signal that identifies it with a computer system. RF tags are used as alternatives for bar-coding systems in working environments where bar code labels would not survive.

The salmon tags, manufactured by Identification Devices Inc. of Boulder, Colo., cost about $5 apiece. When the fish are still in the hatcheries, the tags are injected into the body cavity with a hypodermic needle. Each tag has a unique code that identifies the salmon's species, age, where it was raised, and where it was released. This information is then fed into a central database.

When the fish are released into the two rivers and begin their migration toward the sea, they pass through a number of hydroelectric dams where the NMFS has set up recording equipment that "passively interrogate" the fish. The equipment includes coils placed in the water that send 400-kilohertz signals which activate 40kHz to 50kHz return signals from the transponders. This acts as a time stamp for each particular fish. The information is processed and then compared with the initial file that was established at the hatcheries.

The compiled data is used to make sure that none of the hydroelectric stations is interfering in the migration of the fish: a regulation mandated by the U.S. Congress in 1980. The data is also used to determine survival rates and the timing of fish compared with the flow of the river. Prentice estimates that about 23,000 fish have been tagged so far. There is room for upward of 34 billion of these unique tags available for this project.

Although not a typical application, RF tagging of fish is proving very successful. Compared with the traditional method of freeze branding, RF tagging allows the sample to be reduced by up to 95%. Also, the fish do not have to be handled after the initial injection and both accuracy and reliability of tracking are greatly improved. Prentice claims accuracy is higher than 99%. □

change is in laser scanners, a field in which Symbol Technologies is a leader. The big trend is laser diode scanners which are beginning to replace the more conventional helium-neon laser scanners. The advantage of diode scanners is that they use only about one-sixth the power supply that helium-neon lasers use and, therefore, are more portable and more powerful. With the extra space available in these handheld units, interface and decoding circuitry can then be stuffed inside, eliminating the need for separate interface units.

There is no argument that technological innovation is driving prices of hardware down. But some industry watchers speculate that because there are over 300 companies vying for a piece of the bar code market the increasing competition will drive prices down even further. Others contend that there is plenty of business to be had by all, and that no company has the clout to force price degradation. The latter seems to be the opinion held by the majority.

Coe, at Deloitte, Haskins & Sells, believes that prices are dropping as a result of technological innovation. He speculates, however, that as the industry matures, there will be a paring down in the number of companies in the market. Intermec's Palmer agrees: The industry will eventually move toward an oligopoly a few years down the road, he predicts.

Although bar coding is the primary method of automatic identification, other methods do exist. Most experts agree, however, that there is little chance of any technology replacing bar codes in the foreseeable future. One of the most notable technologies is the use of radio frequency transponders, commonly called RF tags. These are small systems, sometimes the size of a grain of rice, that, when activated by a transmitter, send a unique radio signal to a receiver.

> The industrial marketplace offers the greatest potential for growth

RF tags are a logical choice for hostile industrial environments where bar codes would not survive; such as in automotive paint shops or in factory processes that subject products to extreme temperatures. An issue that is holding up the widespread use of RF tags is the problem of standardization. Without standards, production runs tend to be short and unit costs are correspondingly high. Compared with paper bar code labels that cost almost nothing, the cost of an RF tag ranges between a few dollars to as much as $50.

Although RF tags may never replace bar codes, independent management consultant John Gallagher contends that they do have a viable market. From a recent survey he conducted, one of the top three issues concerning bar codes was that they were not applicable to the respondents' industrial processes. Coe of Deloitte, Haskins & Sells agrees that RF tags have their place. He says that once standards are established there will be a drop in their unit cost and an explosion in their acceptance.

Currently, most RF tags are read-only, but progress is being made in the field of read-write tags. The advantage of a read-write tag is that it can carry its own database which can be updated periodically: an example of further decentralization. One possible application of read-write tags is in the automotive industry, where a tag would be attached to an engine block. Whenever the car is serviced, the mechanic can read the car's service history, and then update it after the checkup.

Reading the market

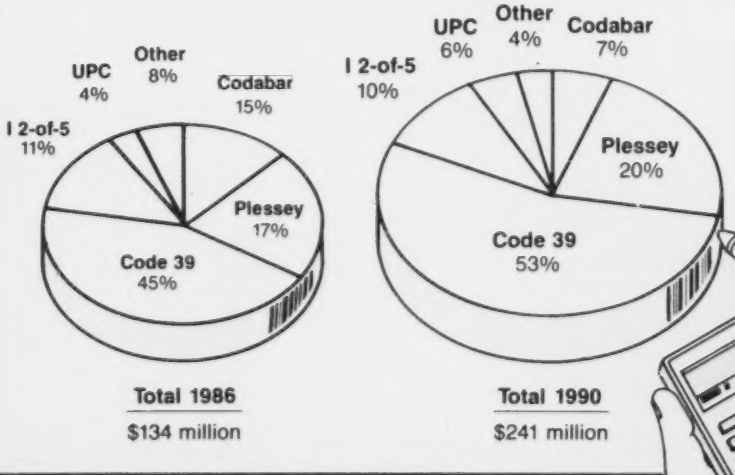
Most vendors and analysts agree that the industrial marketplace offers the greatest potential for growth. Industrial use of bar codes currently comprises less than 5% of potential factory applications, claims the Frost and Sullivan bar code report. Gallagher, who is the author of this study, contends that if this market is to enjoy the growth the industry seems to expect, then it must concentrate on educating the customer.

Richard Bravman, vice president for marketing at Symbol Technologies, agrees that education is crucial and believes it is the factory automation market that offers the greatest potential for growth. However, it is also the most difficult market to penetrate. Buying strategies differ markedly between industrial users and retail users, Bravman contends. While a retail chain may order 7,000 scanners for use in all company locations, an industrial customer will typically buy only 100 units for a particular plant or a division within a plant.

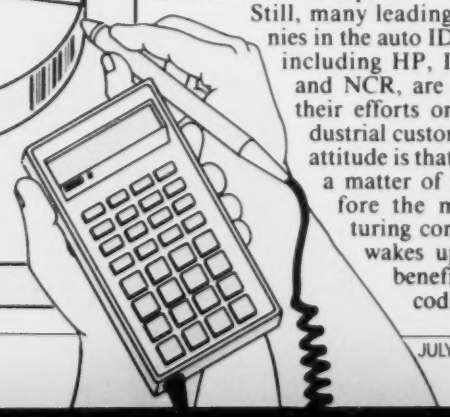
Still, many leading companies in the auto ID market, including HP, Intermec and NCR, are focusing their efforts on the industrial customer. The attitude is that it is just a matter of time before the manufacturing community wakes up to the benefits of bar coding. □

Bar code label shipments

Percentage of U.S. market share by symbology ($ millions)



Source: Ross Associates Inc.



The making of a military GaAs market

Commercial chip makers may be cautious about gallium arsenide, but military vendors foresee increased demand

By Valerie Rice

High-priced and temperamental gallium arsenide (GaAs) has found a home in the military market. While many commercial merchants have yet to make serious investments in GaAs, military suppliers are forging ahead, garnering the lion's share of the current GaAs market.

In 1986 total worldwide production of GaAs products (both merchant and captive, as well as pure R&D) was $2.4 billion and is projected to double by 1990, according to market research firm Henderson Associates, Los Altos, Calif. Of that total, military production (also including captive) represented $430 million in 1986 and will be $1 billion in 1990.

Looking at just integrated circuits, the GaAs worldwide market in 1986 was $240 million, of which 70% was military, according to Henderson Associates. By 1990, according to market research firm Mackintosh International, Luton, England, the military IC market will account for 58% of GaAs sales in the United States.

Although even GaAs fanatics concede that the current number of systems with GaAs parts is fairly small, the process is beginning to gain attention as a high-speed solution for phase array radar systems, electronic warfare systems, satellite and space-to-space communications, missile guidance and "smart" weaponry. Widespread acceptance in these areas will probably not happen until the early 1990s, but a number of companies are finding a large amount of business — particularly in research and development dollars — in the military GaAs arena.

Colorado Springs, Colorado-based Ford Microelectronics Inc. does about 80% of its GaAs business with the military, says GaAs marketing manager Charlotte Diener. Ford has also invested $33 million since dedicating a building to GaAs production in 1985, she says.

Watkins-Johnson Co., a military systems supplier and a captive producer of GaAs cannot even begin to quantify the investment made in GaAs, says vice president Keith Kennedy. The company has been in GaAs almost 20 years and has over 60 people involved in full-time development of GaAs products.

AT&T Bell Laboratories, Princeton, N.J., which just signed a $19.8 million deal with the Defense Advanced Research Projects Agency (DARPA) to make 4K dynamic RAMs, is very excited about GaAs, says compound semiconductor lab director Bernard Murphy, and the company is planning to sell its products on the merchant market in 1988.

> A large number of companies are finding a large amount of business in the military GaAs arena

As a relatively untried technology, GaAs was ripe for the picking. The question was, which side of the market would make the first move? Several years ago it appeared that the commercial market might forge ahead, but that short-lived burst of activity is now recognized as premature. Instead, the military market has quietly been encouraging its suppliers and putting its effort into two very different directions. The first is toward the development of digital GaAs, particularly static RAMs, and the second is the development of a program similar to very high speed integrated circuits (VHSICs) called MIMICs for monolithic millimeter and microwave integrated circuits, all to help GaAs gain a toehold in the market.

Grow your own

Although the technology is hard to work with, and relatively difficult to "grow your own," it has four properties that make the difficulties seem trivial. Most important, it has "blinding speed," as one GaAs executive describes it, and low power requirements. It is inherently more radiation-resistant than silicon, making it ideal for certain Strategic Defense Initiative

Worldwide GaAs merchant consumption forecast by technology

($ millions)

	1984	1985	1986	1987	1988	1989	1990
Analog ICs	$46	$80	$177	$173	$237	$313	$387
Digital ICs	11	26	61	17	216	352	585
Discrete optoelectronic	1,152	1,089	1,361	1,602	1,811	1,866	2,136
Integrated optoelectronic	8	20	28	43	67	104	162
Microwave transistors	122	156	210	273	341	410	450
Total	**$1,339**	**$1,371**	**$1,777**	**$2,108**	**$2,672**	**$3,045**	**$3,720**

Source: Dataquest Inc.

applications; and it can operate at much higher frequencies than anything else developed. All four of those properties make it invaluable to the military, says Ford's Diener. The commercial market, on the other hand, is probably only interested in the speed and maybe the power, she says, providing one clue as to why GaAs is so popular with the military.

"The only reason anybody would invest in another [process] material is because it gives you an advantage in parts," says Harris Corp. Semiconductor Division's GaAs operations vice president Joe Barrera. "The primary advantage is that you can build a variety of parts with different signals, higher speeds and frequency increases. GaAs has inherently higher speeds."

GaAs, surprisingly, is really not even a new technology to the military. Although recent applications are brand new, GaAs has been around in different incarnations for years. Harris, for example, has been supplying discrete field effect transistors (FETs) in GaAs since the late 1960s, and discrete FETs are still 60% of the company's business.

The latest GaAs development has been in the digital IC area. Bell Labs, Ford Microelectronics and Harris, to name a few, are all investing heavily in the push into digital ICs. Mackintosh analyst Kheldun Kahn says that the development of the digital and analog GaAs markets are quite different. "In digital there is nothing but start-ups," he says. "In analog, it is existing companies, who are active in special niche markets, some for as many as two decades. They are slowly evolving towards products. With digital it is more of a revolution in terms of technology. The takeoff is slow."

Some GaAs start-ups and products

Company	Digital ICs	Analog ICs	Opto-electronic	Field effect transistors
ABM Semiconductor San Jose, Calif.	NA	NA	Yes	NA
Anadigics Morristown, N.J.	Yes	Yes	No	NA
Celeritek San Jose, Calif.	Yes	NA	NA	Yes
Gain Electronics New York, N.Y.	NA	NA	NA	NA
Hittite Microwave Lexington, Mass.	Yes	NA	NA	NA
Isocom Campbell, Calif.	No	No	Yes	NA
ITT GaAs Technology Center Roanoke, Va.	Yes	NA	Yes	NA
Les Technologies OMVPE Quebec, Canada	No	No	No	No
Lytel Somerville, N.J.	NA	NA	Yes	NA
Microwave Technology Fremont, Calif.	Yes	NA	NA	Yes
Pacific Monolithics Sunnyvale, Calif.	Yes	NA	NA	NA
Plessey Three-Five Group Towcester, Northamptonshire, Britain	Yes	Yes	Yes	Yes
Sanders Associates Nashua, N.H.	Yes	NA	NA	NA
Techonics Bethpage, N.Y.	NA	NA	NA	NA
Triquint Semiconductor Beaverton, Ore.	Yes	Yes	NA	Yes
Vitesse Electronics Camarillo, Calif.	NA	Yes	NA	NA

NA — Not available

Source: Dataquest Inc.

A new breed

Harris' Barrera says that the new breed of GaAs digital ICs (Harris calls them "digics") are "meant to be emitter-coupled logic level compatible. They will do the same things but at [much] faster operation. For example, a GaAs part will have a 2-gigahertz clock rate versus a 10-megahertz clock rate for a similar silicon part."

Texas Instruments Inc. has internal digital capability at the present and is incorporating some digital products in its military group, but is waiting to see what the market brings before going merchant, says manager of microwave components Thomas Kilgo.

According to Kahn, waiting is not such a bad idea. "There has been a lot of hype in the GaAs market which is the result of proponents of the process characteristically underestimating the maturation cycle of GaAs. Users are finding it difficult to get parts, and vendors have underestimated the difficulty in development. Yields are very low."

One of the reasons yields are low is that the parts are very sensitive, Kahn says. He tells a story of one early-release GaAs part that had to be breathed on before it would run, and if it was fanned to cool it off, it would stop.

With the low yields come the high prices. The price of a typical hardware multiplier in GaAs can run between $300 and $400, while the same part in silicon CMOS, admittedly much slower, at $50, is seven to eight times cheaper, says Kahn. And silicon is not likely to go away, even if the prices of GaAs drop, says Bell Labs' Murphy. The technology that makes GaAs so fast also makes it impossible to use for DRAMs, certainly the cornerstone of silicon technology, and much of the IC-based electronics industry. So for the time being, silicon will retain its grip on the low-end military market while GaAs will be targeted at the high end.

One early DARPA-funded participant in digital GaAs has since discontinued its production. Honeywell Inc.,

Minneapolis, pulled out of the digital arena at the beginning of 1987, after reevaluating its internal needs, a spokeswoman said. The company had a dedicated plant in Richardson, Texas, which is currently being converted to other products. Honeywell is still servicing its military customers in the analog and photoelectronics areas. "Our internal need was predominantly for analog circuits in the aerospace and defense areas," the spokeswoman said. "The decision was purely a business one."

Yet despite the problems, there is pressure to generate product, Ford's Diener explains. "I know up until 1984 Japanese companies spent $300 million to $400 million on GaAs research. For that time the U.S. spent about a third of that, I would guess," she says.

Drunken sailors

"The Japanese are spending money like drunken sailors on GaAs," echoes consulting firm McKinsey & Company Inc. principal Robert J. Neely. "Each of the major companies is spending $50 million to $100 million per year."

"The Japanese companies are very good in GaAs. They have spent a lot of dollars and effort in this area," Dataquest Asian Service director Thomas Wang says. According to Wang, the Japanese are currently involved in developing very large scale integration (VLSI) GaAs chips for use in the supercomputer market.

> The Japanese are currently involved in developing VLSI GaAs chips for use in the supercomputer market
>
> Thomas Wang of Dataquest

Henderson Associates' Ken Taylor stresses that the Japanese are a threat in the military market, however, despite their internal concentration on digital products. According to Taylor, the Japanese virtually own the military satellite segment of the GaAs market, and the Defense Science Board is worried about this trend toward increasing dependence. "The Japanese have very good GaAs devices, and high tech military contractors are buying them and putting them in military products," Taylor says. "This is a major concern."

But the Japanese are not spending their efforts on defense development, but rather on more commercial products, Wang says. The Japanese companies are developing SRAMs predominantly for use in supercomputer.

"The companies who are working hardest on supercomputers are working hardest on GaAs," Neely stresses. Although a number of U.S. companies, including IBM, are working internally on GaAs development, Neely believes that it may be late in the game. "Folks like Cray don't have substantial in-house development to my knowledge; they can get into close partnerships, but they are not as far along as if they were doing it all internally. The smaller start-ups are way behind the Japanese."

Supercomputer solutions

The military push can't hurt GaAs development, Neely says, but the fact that it is not geared directly toward digital products may mean that the United States will have trouble catching up, particularly in the supercomputer market.

Wang believes, however, that in five years costs will drop, allowing the United States to move GaAs applications into a more broad-based commercial environment. In the meantime, only very large and speed-hungry U.S. companies, like Cray Research Inc., are delving into the world of GaAs digital products — primarily through a variety of U.S. GaAs subcontractors.

> Only very large and speed-hungry U.S. companies are delving into the world of GaAs digital products

Despite some concerns surrounding digital products, the MIMIC program is moving strongly ahead. Historically, military GaAs solutions were hybrid combinations of packaging, microwave technology and transistors that often took up large amounts of space and required significant investments in time and testing. With the new MIMIC program, the push is on to offer a monolithic solution — that is, build up on a chip instead of out onto a larger surface area. The MIMIC program is structured with 12 contractor teams participating in a number of "phases" of study in an effort to increase the capabilities of GaAs circuits while reducing their size and cost.

For microwave applications, GaAs is the perfect solution for smaller surface areas, and less dollars in test and engineering, and higher reliability, says TI's Kilgo.

TI has been a captive supplier for a number of years and recently entered the merchant market with a limited number of design-ins for standard products. "Our business breaks down into hybrid technology and monolithic technology," Kilgo explains. "A large percentage has been hybrid technology, but we are going to bring to bear our monolithic technology on the market."

The largest problem, of course, is price. Monolithic products tend to compete not just with silicon, but with hybrid solutions containing silicon, Kilgo says. Also the nonrecurring expenses with monolithic products, particularly in the early stages, are much higher than with hybrids, even though the reliability is also much higher. However, this year TI will see its first product program for the Department of Defense, a monolithic-based component device, and Kilgo is optimistic that as yields and volume increase, prices will go down.

One group that has undoubtedly benefited from projects like the MIMIC program is semiconductor equipment manufacturers, which are now being called upon to develop sophisticated equipment to help manufacturers meet their customers' needs.

EmCor Corp., a South Plainfield, New Jersey-based manufacturer of GaAs equipment, has grown, thanks to the increase in government contracts for GaAs development, says finance and administration vice president Bernard L. Riley. "There are a number of government-funded programs and there certainly has been a positive impact in terms of an increased need for equipment for growing GaAs," Riley says.

According to Riley, the equipment market for GaAs is relatively small, somewhere between $25 million and $30 million, and there is a very small number of major players (four or five at the most). One of the reasons, Riley explains, is that the philosophy until around 1984 was for companies and research institutions to "build their own" equipment. Now, with the GaAs market expected to grow significantly in the next few years, Riley is expecting increased demand for equipment to keep up with the growth. □

Wiser, leaner and financially meaner

The U.S. electronics industry matured in 1986 when the battle of the bottom line became survival of fiscally fittest

By Eric Lundquist and Linda Stallmann

The year of the bottom line. The year when companies displaying the best business acumen clearly outdistanced the technology worshippers. The year when a young industry turned the corner to maturity. The year when the ELECTRONIC BUSINESS 200, the financial gauge of the computer and electronics industry, saw revenue rise to $279.2 billion while net income fell to $26.7 billion. In 1986 the major U.S. electronics and computer companies which make up the ELECTRONIC BUSINESS 200 displayed all the woes that beset the boisterous industry, along with all the promise that a mature fiscal wisdom portends.

First, some facts. The ELECTRONIC BUSINESS 200 is an exclusive report by ELECTRONIC BUSINESS magazine analyzing the revenue of the 200 largest U.S.-based computer and electronics manufacturers. The report is based on a careful analysis of thousands of annual reports, interviews with company executives, and estimates developed internally at the magazine. As such, the 200 provides an accurate gauge of the current status and future direction of the U.S. electronics industry.

NEW COMPANIES IN THE 200

Company	Rank
ADC Telecommunications	186
Ametek	167
Anthem Electronics	198
Applied Magnetics	194
Ashton-Tate	141
Atari	115
Bolt Beranek and Newman	148
BRIntec	130
Data Card	175
Digital Communications	176
Genicom	174
Intelligent Systems	187
Lotus Development	106
Mark IV Industries	180
Maxtor	184
Micropolis	138
Microsoft	114
MiniScribe	158
Olin	199
Reynolds & Reynolds	132
Sun Chemical	191
Sun Microsystems	93
Textron	83
Thomas & Betts	200
UCCEL	188
Ultimate	172
Unisys	7
Wyse Technology	131

THE 200 ON A DISK

IBM-compatible Lotus format or Apple Macintosh Excel versions of the ELECTRONIC BUSINESS 200 are available for $50. Please specify. Write to: The Editor, ELECTRONIC BUSINESS, 275 Washington Street, Newton, Mass. 02158

Change, which is always a constant in any vibrant industry, was especially evident in the 1986 ELECTRONIC BUSINESS 200 listings. Twenty-eight new companies joined the list replacing those U.S. firms that either merged, were taken over, or whose plummeting revenue drove them out of the 200 ranks. Software firms have now made their appearance as a separate product category. IBM, the perennial first place winner, continued to widen its revenue lead over the rest of the pack. The billion-dollar club, those 51 companies that command the industry, continued to show an even more commanding influence.

But, even though the revenue results position the winners, it is often the other categories' results that foretell the changes that will unfold over this year. The most obvious change, and one apparent in the income line, is that many companies spent 1986 cleaning up their bottom lines and taking the financial hits that were necessary to come out of a recession with a recharged balance sheet capable of mounting a market share assault. A second major change was the remarkable growth in importance of foreign revenue. It was foreign revenue that sustained many U.S. firms through the 1986 sales drought.

Each year we have a goal of increasing the amount of information that we provide in the 200 listing. This year, we met and surpassed our goal of continually expanding the 200. In addition to the tabular material that has made the ELECTRONIC BUSINESS 200 the most referenced electronics and computer company listing in the industry, we have provided profiles of the companies whose electronics sales have gained them admittance to the billion-dollar club. □

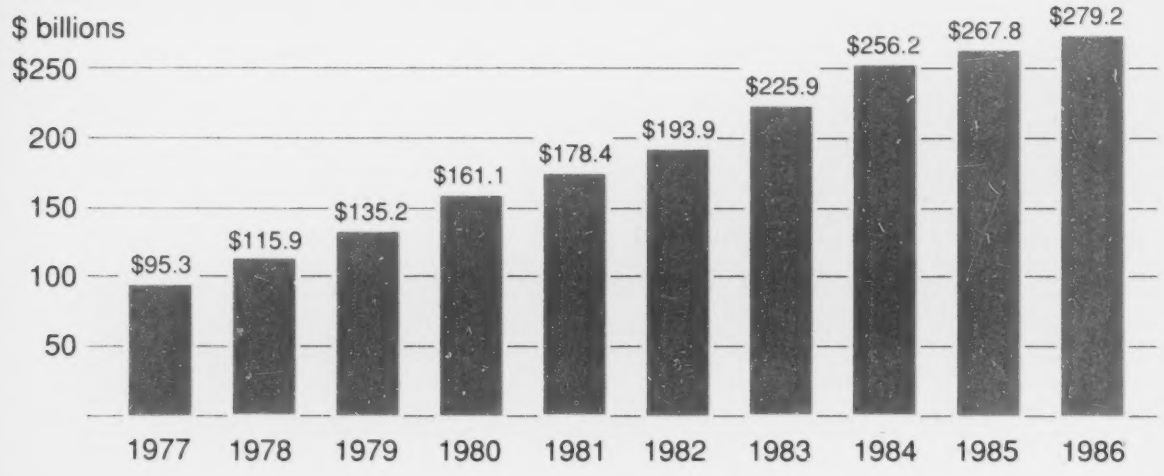
COMPOSITE PERFORMANCE

	1983	1984	Percentage change	1985	Percentage change	1986	Percentage change
Electronics sales ($ billions)	$225.9	$256.2	13.4%	$267.8	4.5%	$279.2	4.3%
Total sales ($ billions)	$732.5	$776.5	6.0%	$797.8	2.7%	$641.7	-19.6%
Net income ($ billions)	$37.4	$46.4	24.1%	$35.4	-23.7%	$26.7	-24.6%

WEIGHTED AVERAGES

	1983	1984	1985	1986
Return on equity	13.8%	16.5%	11.8%	10.2%
Return on investment	10.2%	12.6%	8.7%	7.2%
Cost of goods sold as a percentage of sales	70.0%	69.4%	70.3%	63.7%
R&D as a percentage of sales	4.1%	4.2%	4.2%	5.0%
Sales per employee	$97,300	$103,200	$110,800	$102,348
Net income per employee	$5,100	$6,300	$5,000	$4,266
Five-year compounded annual growth				
Sales	8.5%	8.5%	5.0%	8.2%
Net income	7.3%	11.6%	1.4%	4.0%
Capital outlay to net cash flow after dividends	89.8%	96.0%	118.3%	97.9%
Debt as a percentage of total capital	26.1%	23.5%	26.7%	29.9%
Foreign sales as a percentage of total sales	NA	NA	14.0%	25.4%

GROWTH OF THE TOP ELECTRONICS COMPANIES



BY JERRY WASSERMAN

The continuing tale of toil and turmoil

1986 continued the trend toward transition and change and reflected the repositioning of company strategies

The tale of toil and turmoil noted in the 1985 performance of the annual ELECTRONIC BUSINESS leading 200 companies continued through 1986. Mergers, acquisitions and divestitures all contributed to the ongoing state of flux. Industry revenue continued to grow to reach an all-time high of $279.2 billion in 1986. However, net income dropped by 25% from $35.4 billion in 1985 to $26.7 billion in 1986, indicating that companies must become more cost effective to remain competitive.

This year, 28 new companies entered the list, eight more new entrants than in 1985. The electronics revenue of the 200th company on the list increased by 6.8% from $123.6 million in 1985 to $132 million in 1986. Fourteen companies from the 1985 list disappeared due to merging, consolidation and divestiture; a key issue for the high number of new entrants. This consolidation process should continue through 1987. In addition, foreign companies will enter the U.S. market more aggressively and become significantly visible among the acquiring companies.

For the first time, ELECTRONIC BUSINESS included software companies in the top 200 list. Lotus Development Corp. entered at position number 106, with 1986 revenue of $283 million; followed by Microsoft Corp.; Reynolds & Reynolds Co.; and Ashton-Tate Corp., at position No. 141, with revenue of $211 million. Users are placing an increasing value on the software content of products in contrast to the traditional industry practice of just buying hardware.

From a performance perspective, the four software companies noted above were all robust. Their net income, return on equity, and return on investment were superior to the rest of the companies on the ELECTRONIC BUSINESS top 200 list.

The percentage of revenue invested in research and development in 1986 increased by 19%, from the 1985 value of 4.2% of total revenue to 5% of total revenue. However, we would like to stress an observation that we made years ago: Using research and development investment as an indication of performance is not necessarily valid. In the electronics industry, performance still requires that a company be cost competitive.

In 1986, the cost position looked impressive. Cost of goods sold decreased from 70.3% of total revenue in 1985 to 63.7% of total revenue in 1986. However, before we get too complacent, we must note that this positive indicator was accompanied by two negative indicators.

> A strong positive factor for the industry was an increase in foreign revenue. The 1986 total showed a hefty increase to 25.4% from the 1985 level of 14%

The net income of the ELECTRONIC BUSINESS top 200 companies dropped significantly — by 25% — from $35.4 billion in 1985 to $26.7 billion in 1986. In addition, the accumulation of debt increased to a level that is too high for the industry to maintain. Debt as a percentage of total capital rose from 26.7% in 1985 to 29.9% in 1986. This 12% increase is significant and must be adjusted in the short term. Should the high debt continue, the electronics industry will soon find itself in trouble, as many of the U.S. capital goods industries are in today.

There is also a realistic concern that the industry is being milked to show short-term profits. This is indicated in the drop in capital outlays to net cash flow after dividends, which fell from a healthy 118.3% in 1985 to a suspect 97.9% in 1986. This indicator shows how a company uses internally generated funds to support its capital expenditures on new plant and equipment. Clearly, in our increasingly competitive environment, investments in new plant and equipment are critical for a company if it is to remain competitive in this ever cost-conscious industry. Our experience has been that companies which invest between 100% and 130% of net cash flow after dividends in capital equipment are making prudent use of their funds for growth. Anything below 100% suggests that the company is being milked for profits.

A strong positive factor for the industry this year was an increase in foreign revenue. The 1986 industry total showed a hefty increase to 25.4% from the 1985 level of 14%. This is extremely important because it illustrates the clear recognition of management concerning the international character of the market and the resultant strategic thrust to expand company horizons from a domestic focus in the United States to a view of a worldwide market which must be penetrated.

Too many electronics industry chief executives are looking toward the short term in a frantic attempt to boost profits so that they can justify their existence. This indicates that 1987 may be a potentially disastrous year for a number of companies. On the other hand, the recognition of the importance of foreign sales, the increasing acceptance of software as a significant industry thrust, and the ongoing consolidation process could create a positive balance that will keep the electronics industry on an even keel in 1987, and perhaps even put it into an upward thrust for 1988 and beyond.

Overall 1986 continued the trend toward transition and change, and reflected the repositioning of company strategy and tactics that have been going on in the electronics industry for the past three years.

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200

REVENUE AND PROFITS

Ranking: 1 - 40

Figures in millions for the calendar year

Rank 1986	Rank 1985	Company	Electronics revenue 1986	Electronics revenue 1985	Total company revenue 1986	Total company revenue 1985	Total company profits 1986	Total company profits 1985
1	1	**IBM**	$51,250.0	$50,056.0	$51,250.0	$50,056.0	$4,789.0	$6,555.0
2	2	**AT&T**	14,979.0	17,641.9	34,087.0	34,909.5	139.0	1,556.8
3	4	**General Electric** [1]	11,300.0	7,590.0	35,211.0	28,285.0	2,492.0	2,336.0
4	3	**GM Hughes Electronics**	10,440.0	9,503.8	10,440.0	9,503.8	445.1	339.8
5	6	**DEC**	8,414.3	7,029.4	8,414.3	7,029.4	861.6	400.6
6	5	**Xerox**	8,150.0	7,545.0	9,355.0	8,732.1	488.0	380.5
7	-	**Unisys**	7,432.4	NA	7,432.4	NA	-43.4	NA
8	9	**Hewlett-Packard**	7,245.0	6,571.0	7,245.0	6,571.0	523.0	482.0
9	23	**Allied-Signal**	6,132.9	2,850.0	11,794.0	9,115.0	605.0	-279.0
10	35	**Lockheed** [2]	5,956.0	1,740.0	10,273.0	9,535.0	408.0	401.0
11	10	**Motorola**	5,888.0	5,443.0	5,888.0	5,443.0	194.0	72.0
12	8	**Honeywell**	5,378.2	6,624.6	5,378.2	6,624.6	12.9	281.6
13	13	**Texas Instruments**	4,974.0	4,924.5	4,974.0	4,924.5	39.9	-118.7
14	15	**NCR**	4,466.7	3,952.0	4,881.6	4,317.2	336.5	315.2
15	16	**Raytheon**	4,343.0	3,794.0	7,308.0	6,408.5	393.2	375.9
16	18	**Rockwell International**	4,305.0	3,590.8	12,396.9	11,741.4	634.8	580.6
17	72	**Eastman Kodak**	3,850.0	600.0	11,550.0	10,631.0	374.0	332.0
18	20	**North American Philips**	3,440.0	3,278.9	4,531.6	4,395.2	68.5	81.5
19	21	**Tandy**	3,322.8	3,137.6	3,322.8	3,137.6	225.9	203.9
20	19	**TRW**	3,170.0	3,344.5	6,035.9	5,917.2	217.7	133.7
21	17	**Control Data**	2,682.8	3,679.7	3,346.7	3,679.7	-311.1	-567.5
22	25	**Wang Laboratories**	2,668.9	2,428.3	2,668.9	2,428.3	-86.4	-63.3
23	22	**Litton Industries**	2,660.0	2,875.0	4,290.6	4,568.0	48.4	247.7
24	26	**Westinghouse Electric**	2,545.0	2,350.0	10,731.0	10,700.2	670.8	605.3
25	28	**3M**	2,460.0	2,272.0	8,602.0	7,846.0	779.0	664.0
26	29	**Ford Motor**	2,422.7	2,071.0	62,715.8	52,774.4	3,285.1	2,515.4
27	7	**ITT**	2,300.0	7,010.0	17,437.0	20,007.0	527.9	293.5
28	30	**Martin Marietta**	2,160.0	1,882.1	4,752.5	4,410.1	202.3	249.4
29	27	**Harris**	2,106.4	2,306.6	2,106.4	2,306.6	68.6	60.7
30	50	**Grumman**	2,075.0	1,128.0	3,440.1	3,098.9	78.7	81.5
31	34	**Apple Computer**	2,030.3	1,753.9	2,030.3	1,753.9	155.5	72.0
32	24	**GTE**	2,007.0	2,621.0	15,111.5	15,732.4	1,152.6	-161.1
33	32	**Boeing**	1,975.0	1,850.0	16,341.0	13,636.0	665.0	566.0
34	36	**Zenith Electronics**	1,892.1	1,623.7	1,892.1	1,623.7	-10.0	-7.7
35	33	**Eaton**	1,800.0	1,778.0	3,811.6	3,674.5	137.6	230.9
36	38	**Pitney Bowes**	1,751.9	1,603.3	1,986.7	1,831.8	166.1	144.5
37	42	**Du Pont**	1,750.0	1,400.0	27,148.0	29,483.0	1,538.0	1,118.0
38	39	**McDonnell Douglas**	1,740.0	1,575.0	12,660.6	11,665.8	277.5	345.7
39	37	**National Semiconductor**	1,678.0	1,605.8	1,678.0	1,605.8	-57.0	-89.5
40	44	**AMP**	1,595.0	1,350.0	1,933.1	1,636.1	164.3	108.0

1985 figures are as originally reported in 1985

[1] Includes RCA results from June 1, 1986

[2] Includes Sanders Associates results from July 28, 1986

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REVENUE AND PROFITS

Ranking: 41 - 80

Figures in millions for the calendar year

Rank 1986	Rank 1985	Company	Electronics revenue 1986	Electronics revenue 1985	Total company revenue 1986	Total company revenue 1985	Total company profits 1986	Total company profits 1985
41	45	**Singer**	$1,484.0	$1,338.0	$1,725.2	$2,416.3	$58.5	$82.3
42	31	**United Technologies**	1,413.0	1,877.0	15,699.2	14,991.7	48.1	636.4
43	51	**Teledyne**	1,375.0	1,056.8	3,241.4	3,256.2	238.3	546.4
44	41	**Tektronix**	1,352.4	1,419.8	1,352.4	1,419.8	55.1	70.2
45	47	**Emerson Electric**	1,340.0	1,213.0	5,156.2	4,679.5	414.7	402.1
46	49	**Data General**	1,287.5	1,199.0	1,287.5	1,199.0	7.9	2.4
47	48	**Avnet**	1,287.0	1,201.0	1,476.5	1,384.8	19.2	31.3
48	43	**Intel**	1,265.0	1,365.0	1,265.0	1,365.0	-183.3	1.6
49	53	**Northrop**	1,247.9	938.3	5,608.4	5,056.6	41.2	214.4
50	46	**Perkin-Elmer**	1,182.0	1,222.0	1,303.4	1,310.0	62.1	79.5
51	59	**E-Systems**	1,008.8	806.1	1,145.5	926.8	61.6	59.5
52	56	**Amdahl**	966.3	862.0	966.3	862.0	39.3	24.4
53	40	**Gould**	908.8	1,420.1	908.8	1,420.1	34.6	-100.8
54	65	**Contel**	900.0	681.0	3,074.0	2,556.6	232.9	239.9
55	68	**General Dynamics**	900.0	640.0	8,892.0	8,163.8	-62.6	373.0
56	52	**Varian Associates**	893.4	962.9	893.4	962.9	-8.8	15.3
57	58	**General Instrument**	871.7	824.7	871.7	824.7	16.2	-106.7
58	60	**Prime Computer**	860.2	769.7	860.2	769.7	46.9	57.8
59	61	**Chrysler**	860.0	744.0	22,586.3	21,255.5	1,403.6	1,640.0
60	69	**Tandem Computers**	835.8	634.5	835.8	634.5	79.2	32.0
61	67	**Johnson Controls**	833.0	657.0	2,535.2	2,105.2	83.2	88.4
62	64	**Telex**	817.0	683.1	817.0	683.1	72.7	67.1
63	79	**Emerson Radio**	770.6	502.9	770.6	502.9	28.4	10.5
64	55	**General Signal**	754.3	867.5	1,583.4	1,800.9	74.6	49.3
65	63	**Penn Central**	730.0	685.0	2,387.9	2,527.3	154.2	110.8
66	100	**Seagate Technology**	709.5	303.6	709.5	303.6	90.4	8.7
67	66	**Storage Technology**	696.0	673.4	696.0	673.4	16.8	-57.4
68	73	**Loral**	683.6	562.0	683.6	599.1	56.6	48.7
69	78	**COMPAQ Computer**	625.2	503.9	625.2	503.9	42.9	26.6
70	71	**SmithKline Beckman**	619.6	619.0	3,745.4	3,256.6	521.1	514.4
71	70	**Advanced Micro Devices**	615.2	623.8	615.2	623.8	-103.9	0.5
72	76	**Intergraph**	605.7	526.4	605.7	526.4	70.4	67.8
73	88	**Cray Research**	596.7	380.2	596.7	380.2	124.8	75.6
74	74	**Corning Glass Works**	580.5	534.8	1,856.3	1,690.5	162.2	133.3
75	57	**M/A-COM**	577.6	855.4	577.6	855.4	-21.9	32.6
76	81	**Tracor**	577.0	498.0	632.1	546.5	18.8	13.4
77	77	**Monsanto**	540.0	520.0	6,879.0	6,747.0	433.0	-98.0
78	80	**Arrow Electronics**	501.8	500.0	529.6	534.1	-28.3	-10.9
79	84	**Computervision**	494.7	441.1	494.7	441.1	-5.8	-80.8
80	75	**SCI Systems**	487.9	527.6	487.9	527.6	14.6	14.2

1985 figures are as originally reported in 1985

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REVENUE AND PROFITS

Ranking: 81 - 120

Figures in millions for the calendar year

Rank 1986	Rank 1985	Company	Electronics revenue 1986	Electronics revenue 1985	Total company revenue 1986	Total company revenue 1985	Total company profits 1986	Total company profits 1985
81	83	Scientific-Atlanta	$479.6	$443.7	$479.6	$443.7	-$7.4	$16.8
82	82	United Telecommunications	460.3	475.0	3,058.8	3,198.4	187.2	20.8
83	-	Textron	445.0	121.2	5,023.3	4,038.5	241.6	251.8
84	124	Xidex	419.0	225.0	533.5	342.1	32.6	25.6
85	87	Medtronic	397.0	387.6	469.2	387.6	69.8	49.3
86	101	Apollo Computer	391.7	295.6	391.7	295.6	9.3	-1.5
87	90	Ducommun	386.6	347.5	455.2	419.6	-19.2	-3.3
88	95	Tyler	384.3	325.3	961.4	912.4	11.9	15.4
89	122	Western Digital	352.8	227.6	352.8	227.6	32.4	-2.9
90	89	Dataproducts	350.8	370.6	350.8	370.6	14.6	-29.7
91	110	Molex	349.4	255.4	349.4	255.4	38.9	28.2
92	85	Compugraphic	341.1	400.8	341.1	400.8	3.4	21.8
93	-	Sun Microsystems	341.1	NA	341.1	NA	24.5	NA
94	94	Diebold	340.0	329.0	413.7	410.9	34.9	30.4
95	97	Analog Devices	336.1	319.7	336.1	319.7	20.2	26.4
96	91	EG&G	325.0	337.0	1,145.1	1,177.1	44.9	55.7
97	99	Cubic	318.0	305.0	344.9	341.7	2.5	12.2
98	93	Datapoint	317.3	331.3	317.3	331.3	-67.3	-68.7
99	143	AM International	317.0	186.0	959.7	614.0	0.7	23.3
100	92	Teradyne	306.1	336.4	306.1	336.4	0.2	20.2
101	86	Convergent Technologies	305.8	395.2	305.8	395.2	-32.8	11.5
102	102	DSC Communications	304.0	287.6	304.0	287.6	11.0	-63.3
103	96	TIE/communications	298.2	321.3	298.2	321.3	-59.3	-77.9
104	103	Foxboro	293.8	286.0	544.0	572.2	7.1	-34.2
105	116	Dynatech	288.9	238.1	288.9	238.1	23.8	22.0
106	-	Lotus Development	282.9	225.5	282.9	225.5	48.3	38.1
107	106	Kollmorgen	278.0	277.0	319.2	311.0	-19.9	-6.4
108	98	Savin	272.0	310.0	362.7	431.7	-11.1	-102.7
109	120	Marshall Industries	269.2	231.6	269.2	231.6	4.5	1.5
110	108	Premier Industrial	268.0	269.0	442.5	433.7	41.7	39.3
111	107	Dover	263.5	276.0	1,439.8	1,439.5	83.8	100.0
112	112	Paradyne	261.1	252.5	261.1	252.5	-38.5	-31.2
113	111	Augat	260.4	255.0	260.4	255.0	-8.7	12.1
114	-	Microsoft	260.2	NA	260.2	NA	57.7	NA
115	-	Atari	258.1	NA	258.1	NA	25.1	NA
116	131	LTV	257.0	214.0	7,271.4	8,198.8	-3,251.6	-723.9
117	117	Bally Manufacturing	256.0	238.0	1,592.8	1,344.8	23.7	25.6
118	119	Watkins-Johnson	255.4	232.6	255.4	232.6	17.2	18.4
119	105	Emhart	255.0	284.0	2,094.3	1,775.4	-10.2	80.5
120	145	Nashua	254.0	185.0	704.2	621.6	20.6	16.4

1985 figures are as originally reported in 1985

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REVENUE AND PROFITS

Ranking: 121 - 160

Figures in millions for the calendar year

Rank 1986	Rank 1985	Company	Electronics revenue 1986	Electronics revenue 1985	Total company revenue 1986	Total company revenue 1985	Total company profits 1986	Total company profits 1985
121	114	Square D	$252.6	$246.0	$1,403.5	$1,348.1	$98.9	$87.2
122	115	Union Carbide	248.0	240.0	6,343.0	9,003.0	130.0	-581.0
123	125	Eli Lilly	247.0	222.2	3,702.4	3,270.6	558.2	517.6
124	147	Recognition Equipment	246.6	179.4	246.6	179.4	9.7	3.6
125	109	CTS	245.5	261.6	245.5	261.6	-26.6	9.4
126	160	Polaroid	244.0	160.0	1,629.2	1,295.2	103.5	36.9
127	123	Tandon	242.8	225.9	242.8	225.9	-62.6	-119.1
128	136	Cincinnati Milacron	242.0	206.0	850.0	732.2	23.3	-44.8
129	132	Figgie International	240.8	208.0	919.8	803.4	42.4	29.2
130	-	BRIntec	232.0	NA	310.7	NA	11.8	NA
131	-	Wyse Technology	228.4	NA	228.4	NA	16.7	NA
132	-	Reynolds & Reynolds	227.0	NA	452.5	NA	23.4	NA
133	126	Cooper Industries	226.0	220.0	3,433.3	3,067.2	147.7	135.1
134	138	Wyle Laboratories	224.6	195.4	307.0	260.8	4.3	1.5
135	150	Sundstrand	220.0	177.0	1,433.9	1,284.1	45.4	74.4
136	164	Diasonics	217.1	157.9	217.1	157.9	5.9	7.3
137	135	Pioneer-Standard	214.2	207.2	214.2	207.2	-0.4	0.2
138	-	Micropolis	213.1	94.9	213.1	94.9	18.3	2.8
139	134	Gerber Scientific	213.0	207.3	213.0	207.3	19.7	19.7
140	154	Monolithic Memories	213.0	171.6	213.0	171.6	9.9	5.5
141	-	Ashton-Tate	210.8	NA	210.8	NA	30.1	NA
142	137	Spectra-Physics	208.8	198.9	208.8	198.9	0.9	-1.7
143	130	Fluke	208.5	214.7	208.5	214.7	11.6	14.5
144	140	Avantek	208.2	190.3	208.2	190.3	16.1	17.7
145	142	Logicon	204.5	187.9	204.5	187.9	9.3	9.6
146	127	GenRad	204.3	218.3	204.3	218.3	-29.9	-52.3
147	133	Andrew	198.0	207.8	198.0	207.8	9.5	12.2
148	-	Bolt Beranek and Newman	196.6	96.4	196.6	160.6	12.9	9.6
149	148	AVX	195.4	178.7	195.4	178.7	-3.1	-12.3
150	152	Decision Industries	195.1	176.4	195.1	176.4	7.8	7.8
151	176	LSI Logic	194.3	140.0	194.3	140.0	3.9	10.1
152	151	Measurex	192.7	176.6	192.7	176.6	21.1	17.7
153	144	Bell Industries	192.0	185.0	319.1	295.8	3.2	4.5
154	139	Micom Systems	191.6	194.2	191.6	194.2	9.5	14.9
155	128	Bell & Howell	190.0	217.0	853.4	759.8	32.9	32.2
156	146	General DataComm	189.2	179.4	189.2	179.4	3.9	8.7
157	141	Ball	187.5	188.5	1,070.3	1,106.2	58.9	51.2
158	-	MiniScribe	184.9	114.0	184.9	114.0	20.3	-16.8
159	121	NBI	181.0	230.0	283.1	260.7	-10.4	7.8
160	167	Cipher Data Products	180.8	152.5	180.8	152.5	7.5	7.9

1985 figures are as originally reported in 1985

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REVENUE AND PROFITS

Ranking: 161 - 200

Figures in millions for the calendar year

Rank 1986	Rank 1985	Company	Electronics revenue 1986	Electronics revenue 1985	Total company revenue 1986	Total company revenue 1985	Total company profits 1986	Total company profits 1985
161	187	Electrospace Systems	$179.9	$133.2	$179.9	$133.2	$10.0	$12.6
162	166	Kidde	175.0	155.0	2,356.2	2,164.8	52.2	72.2
163	162	ADT	174.3	158.0	519.2	479.6	22.3	-56.6
164	180	Mentor Graphics	173.5	136.7	173.5	136.7	11.0	8.0
165	161	Allen Group	173.0	159.0	423.2	399.2	-8.6	16.7
166	170	Veeco Instruments	170.7	150.4	170.7	150.4	0.5	7.3
167	-	Ametek	170.0	106.7	568.5	502.8	36.6	34.9
168	155	AST Research	168.9	171.0	168.9	171.0	17.3	29.2
169	179	Sun Electric	167.0	139.0	186.0	168.8	2.5	-7.8
170	189	Analogic	166.5	132.4	166.5	132.4	17.3	10.3
171	163	Tyco Laboratories	166.0	158.0	1,037.6	646.2	42.6	31.1
172	-	Ultimate	163.0	NA	163.0	NA	13.9	NA
173	158	ISC Systems	162.4	161.5	162.4	161.5	10.8	11.5
174	-	Genicom	157.5	NA	157.5	NA	8.6	NA
175	-	Data Card	157.0	123.2	182.5	136.9	2.1	10.4
176	-	Digital Communications	156.9	114.1	156.9	114.1	22.9	14.7
177	174	International Rectifier	151.7	142.0	151.7	141.1	0.2	-0.8
178	159	Applied Materials	151.5	160.1	151.5	160.1	-0.5	5.9
179	173	Esterline	151.0	142.0	233.6	246.1	0.6	0.0
180	-	Mark IV Industries	151.0	NA	244.8	NA	9.1	NA
181	169	Becton, Dickinson & Co.	150.0	151.0	1,389.7	1,156.1	124.8	92.4
182	157	Unitrode	149.4	168.0	149.4	168.0	-7.0	9.2
183	193	Dynascan	146.8	128.1	146.8	128.1	6.1	0.1
184	-	Maxtor	147.9	NA	147.9	NA	22.2	NA
185	175	Mark Controls	145.0	140.8	262.7	279.0	1.5	2.7
186	-	ADC Telecommunications	144.9	NA	144.9	NA	11.4	NA
187	-	Intelligent Systems	143.5	122.7	143.5	122.7	1.8	-8.3
188	-	UCCEL	141.6	NA	141.6	NA	17.2	NA
189	195	Burndy	140.0	127.0	242.1	219.0	9.5	-9.1
190	153	Pittway	140.0	175.0	585.7	548.5	27.6	31.1
191	-	Sun Chemical	140.0	97.0	371.4	326.6	26.1	1.3
192	190	Altos Computer Systems	139.5	132.2	139.5	132.2	19.1	9.9
193	181	Coherent	138.4	136.6	138.4	136.6	-0.2	5.9
194	-	Applied Magnetics	137.0	120.4	137.0	120.4	4.4	4.0
195	185	United Industrial	137.0	135.0	272.5	269.4	-9.2	19.1
196	188	Aydin	136.8	133.0	136.8	133.0	7.0	3.8
197	177	Fairchild Industries	134.0	140.0	643.3	855.9	7.6	-167.1
198	-	Anthem Electronics	132.7	103.6	132.7	103.6	2.8	3.2
199	-	Olin	132.0	NA	1,707.3	NA	75.2	NA
200	-	Thomas & Betts	132.0	95.4	347.4	318.0	38.0	33.4

1985 figures are as originally reported in 1985

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ALPHABETICAL INDEX

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AM International Inc.	99
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Analogic Corp.	170
Andrew Corp.	147
Anthem Electronics Inc.	198
Apollo Computer Inc.	86
Apple Computer Inc.	31
Applied Magnetics Corp.	194
Applied Materials Inc.	178
Arrow Electronics Inc.	78
Ashton-Tate Corp.	141
AST Research Inc.	168
Atari Corp.	115
AT&T	2
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AVX Corp.	149
Aydin Corp.	196
Ball Corp.	157
Bally Manufacturing Corp.	117
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Bell & Howell Co.	155
Bell Industries Inc.	153
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BRIntec Corp.	130
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Cincinnati Milacron Inc.	128
Cipher Data Products Inc.	160
Coherent Inc.	193
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Cray Research Inc.	73
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Data Card Corp.	175
Data General Corp.	46
Datapoint Corp.	98
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Diebold Inc.	94
Digital Communications Associates	176
Digital Equipment Corp.	5
DSC Communications Corp.	102
Dover Corp.	111
Ducommun Inc.	87
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Litton Industries Inc.	23
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Marshall Industries	109
Martin Marietta Corp.	28
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McDonnell Douglas Corp.	38
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SCI Systems Inc.	80
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Spectra-Physics Inc.	142
Square D	121
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Sun Chemical Corp.	191
Sundstrand Corp.	135
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Tandon Corp.	127
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United Industrial Corp.	195
United Technologies Corp.	42
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INDUSTRY SEGMENTS

Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	Rank
SEMICONDUCTORS								
Western Digital	$113.2	7.7%	13.0%	58.7%	8.8%	5.8%	33.0%	89
LSI Logic	106.7	2.0%	1.1%	50.4%	11.1%	36.3%	21.2%	151
Gould	85.6	3.8%	3.6%	47.8%	10.8%	6.3%	19.3%	53
Intel	69.5	-14.5%	-10.9%	50.3%	18.0%	12.2%	39.9%	48
Analog Devices	67.4	7.0%	7.6%	36.8%	13.5%	11.0%	47.3%	95
Texas Instruments	64.4	0.8%	2.0%	72.6%	8.2%	9.0%	25.8%	13
International Rectifier	63.1	-1.2%	-1.1%	66.2%	6.4%	6.2%	46.4%	177
Motorola	62.4	3.3%	5.7%	54.1%	8.4%	10.1%	38.2%	11
Unitrode	55.2	-4.7%	-5.2%	58.3%	8.2%	6.5%	20.0%	182
Monolithic Memories	48.8	4.3%	3.8%	44.9%	17.2%	16.2%	26.2%	140
National Semiconductor	48.0	-10.0%	-17.5%	63.5%	15.0%	7.9%	37.9%	39
Advanced Micro Devices	43.0	-6.4%	-8.6%	40.8%	31.9%	23.8%	23.9%	71
General Instrument	38.7	-8.4%	-11.3%	76.7%	5.2%	9.2%	19.0%	57
Weighted average	**$60.6**	**-0.7%**	**-1.0%**	**60.0%**	**10.6%**	**10.2%**	**32.0%**	
COMPONENTS (Other than semiconductors)								
CTS	$127.6	-10.8%	-16.0%	77.2%	0.0%	11.0%	17.2%	125
AMP	88.7	8.5%	12.4%	59.2%	8.8%	7.8%	40.1%	40
Kollmorgen	77.8	-6.2%	-13.8%	72.9%	5.2%	3.9%	7.7%	107
BRIntec	70.6	3.8%	8.6%	72.7%	1.9%	2.6%	12.4%	130
Augat	70.3	-3.4%	-3.6%	70.1%	6.4%	9.2%	18.5%	113
Molex	66.3	11.0%	12.0%	45.3%	5.9%	13.7%	63.5%	91
AVX	38.3	-1.6%	-1.5%	72.3%	2.8%	5.7%	34.7%	149
Weighted average	**$78.3**	**4.2%**	**6.0%**	**63.2%**	**6.5%**	**7.7%**	**33.2%**	
PERIPHERALS								
AST Research	$215.4	15.8%	31.0%	42.5%	4.9%	3.7%	27.8%	168
Intelligent Systems	194.6	0.0%	0.1%	62.7%	4.6%	3.2%	20.1%	187
Decision Industries	121.9	4.0%	7.8%	61.9%	5.2%	3.6%	27.0%	150
Micropolis	118.9	8.6%	16.5%	71.8%	5.2%	7.6%	17.7%	138
Wyse Technology	118.6	7.6%	15.5%	64.8%	5.4%	5.3%	13.5%	131
Maxtor	87.1	12.5%	21.1%	65.8%	7.0%	9.1%	25.2%	184
Dataproducts	84.2	-7.6%	-9.8%	70.0%	8.8%	2.6%	23.3%	90
Storage Technology	80.9	2.4%	NA	59.7%	8.9%	4.6%	20.3%	67
Tandon	75.1	-29.3%	-101.4%	86.3%	7.9%	3.8%	69.4%	127
Xidex	66.5	7.5%	5.5%	65.1%	2.5%	12.1%	24.7%	84
Cipher Data Products	65.6	4.4%	5.4%	63.4%	9.2%	3.9%	30.9%	160
MiniScribe	63.8	11.0%	22.3%	71.1%	4.6%	11.4%	22.0%	158
Genicom	63.0	5.5%	12.9%	61.6%	3.9%	2.9%	20.1%	174
Seagate Technology	51.7	7.5%	15.4%	76.2%	4.1%	8.4%	36.7%	66
Applied Magnetics	31.5	3.2%	4.0%	65.4%	13.2%	8.1%	33.9%	194
Weighted average	**$86.3**	**2.1%**	**3.9%**	**65.1%**	**6.5%**	**6.0%**	**25.9%**	

For purposes of comparison, only companies whose electronics revenue constitutes over 70% of total revenue are included

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INDUSTRY SEGMENTS

Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	Rank
MAINFRAMES								
Cray Research	$149.2	20.9%	21.7%	24.5%	14.7%	20.0%	53.8%	73
Amdahl	134.2	4.1%	5.7%	50.7%	12.3%	11.8%	43.5%	52
IBM	127.0	9.3%	12.0%	37.8%	7.8%	9.0%	50.5%	1
Control Data	97.3	-9.3%	-20.0%	61.7%	9.4%	4.7%	32.5%	21
NCR	78.7	6.9%	13.0%	47.3%	6.6%	7.4%	43.8%	14
Unisys	77.4	-0.6%	-0.7%	62.9%	5.9%	7.4%	42.9%	7
Weighted average	**$112.8**	**7.2%**	**9.5%**	**42.5%**	**7.7%**	**8.7%**	**48.3%**	
MINICOMPUTERS								
Tandem Computers	$134.3	8.3%	11.7%	26.7%	11.3%	8.5%	39.6%	60
IBM	127.0	9.3%	12.0%	37.8%	7.8%	9.0%	50.5%	1
Convergent Technologies	124.2	-10.7%	-13.7%	68.3%	10.7%	11.3%	14.0%	101
Apollo Computer	109.5	2.4%	3.0%	46.4%	11.4%	10.6%	47.8%	86
Sun Microsystems	103.4	5.7%	9.4%	45.9%	14.6%	17.2%	20.5%	93
Prime Computer	99.8	5.5%	10.3%	40.1%	10.7%	10.5%	47.2%	58
Telex	94.1	9.7%	16.4%	51.0%	5.5%	14.6%	15.6%	62
Hewlett-Packard	86.6	7.3%	10.9%	42.7%	11.6%	7.0%	46.3%	8
Gould	85.6	3.8%	3.6%	47.8%	10.8%	6.3%	19.3%	53
Data General	81.5	-2.3%	-3.0%	50.9%	11.3%	10.2%	36.4%	46
DEC	80.2	8.1%	10.1%	51.4%	10.7%	7.4%	41.9%	5
Analogic	80.1	6.8%	5.9%	51.3%	12.4%	5.1%	42.4%	170
Weighted average	**$112.1**	**8.5%**	**11.1%**	**40.4%**	**8.7%**	**8.7%**	**47.8%**	
MICROCOMPUTERS								
Apple Computer	$339.6	2.1%	5.7%	44.2%	6.7%	3.5%	25.8%	31
COMPAQ Computer	284.2	6.9%	16.7%	55.3%	4.3%	8.1%	19.1%	69
Altos Computer Systems	186.9	15.1%	18.7%	57.9%	8.0%	1.9%	35.0%	192
Atari	184.4	9.7%	23.3%	57.3%	5.6%	0.3%	53.2%	115
IBM	127.0	9.3%	12.0%	37.8%	7.8%	9.0%	50.5%	1
SCI Systems	90.7	2.9%	7.0%	92.6%	0.0%	2.3%	21.1%	80
Tandy	84.3	6.5%	11.8%	44.9%	0.0%	1.8%	2.6%	19
Weighted average	**$126.9**	**8.9%**	**11.9%**	**39.2%**	**7.2%**	**8.3%**	**46.6%**	
COMPUTER-BASED SYSTEMS								
Intergraph	$106.3	11.6%	13.7%	46.1%	9.5%	12.9%	34.2%	72
Coherent	99.3	-0.6%	-0.8%	61.6%	10.7%	6.4%	42.7%	193
ISC Systems	90.2	8.3%	12.0%	49.5%	9.0%	4.1%	0.0%	173
Hewlett-Packard	86.6	7.3%	10.9%	42.7%	11.6%	7.0%	46.3%	8
Compugraphic	85.4	1.0%	1.5%	49.6%	11.3%	4.3%	24.8%	92
Recognition Equipment	82.0	4.4%	6.0%	56.4%	4.8%	5.0%	46.0%	124
Data Card	79.5	6.9%	12.5%	54.3%	5.8%	7.2%	28.8%	175
Measurex	77.4	10.9%	13.3%	51.3%	7.3%	3.8%	51.0%	152
Sun Electric	70.6	1.1%	3.4%	53.3%	3.2%	1.9%	31.5%	169
Honeywell	68.9	0.2%	0.4%	67.4%	4.6%	5.2%	21.7%	12
Weighted average	**$79.3**	**4.6%**	**6.7%**	**53.0%**	**8.5%**	**6.4%**	**35.3%**	

For purposes of comparison, only companies whose electronics revenue constitutes over 70% of total revenue are included

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INDUSTRY SEGMENTS

Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	Rank
COMMUNICATIONS								
Dynascan	$215.9	4.1%	8.2%	71.5%	1.6%	1.2%	5.1%	183
TIE/communications	175.4	-19.9%	-25.5%	73.9%	7.7%	0.8%	25.7%	103
Digital Communications	156.1	14.9%	17.3%	30.7%	11.3%	6.0%	17.3%	176
Scientific-Atlanta	134.0	-2.0%	-4.3%	71.3%	5.9%	3.7%	16.0%	81
DSC Communications	128.5	3.6%	3.3%	51.8%	15.2%	6.3%	0.0%	102
Dynatech	100.7	8.0%	17.7%	40.9%	8.6%	4.8%	22.9%	105
Micom Systems	93.3	5.7%	6.4%	44.8%	8.4%	4.4%	27.7%	154
Andrew	84.8	4.8%	5.7%	62.0%	6.7%	5.2%	32.3%	147
Bolt Beranek and Newman	84.3	6.4%	13.4%	55.9%	4.8%	9.7%	0.0%	148
ADC Telecommunications	83.1	8.3%	18.7%	46.6%	9.0%	7.0%	10.4%	186
Paradyne	75.5	-14.7%	-0.5%	60.7%	7.4%	7.9%	11.0%	112
General DataComm	70.7	2.2%	2.6%	55.9%	11.0%	9.0%	23.2%	156
Aydin	68.4	5.1%	10.7%	62.8%	5.5%	1.9%	28.1%	196
Avantek	67.0	7.7%	10.9%	50.5%	12.2%	9.7%	14.0%	144
M/A-COM	64.0	1.5%	1.4%	63.0%	5.9%	17.0%	10.2%	75
Motorola	62.4	3.3%	5.7%	54.1%	8.4%	10.1%	38.2%	11
General Instrument	38.7	-8.4%	-11.3%	76.7%	5.2%	9.2%	19.0%	57
Weighted average	**$66.9**	**1.5%**	**1.1%**	**57.4%**	**8.0%**	**9.0%**	**28.7%**	
GOVERNMENT								
GM Hughes Electronics	$102.4	4.3%	6.1%	74.1%	3.9%	8.3%	12.2%	4
Harris	83.0	2.7%	5.4%	61.1%	5.3%	5.3%	6.9%	29
Watkins-Johnson	81.1	6.8%	13.3%	59.3%	6.4%	5.3%	14.2%	118
Loral	81.0	8.0%	12.0%	81.5%	4.7%	7.0%	0.0%	68
Logicon	80.8	5.0%	19.1%	83.2%	0.5%	1.8%	0.0%	145
E-Systems	76.4	5.4%	13.8%	80.5%	0.0%	4.2%	6.9%	51
Cubic	75.1	0.3%	0.7%	77.9%	1.7%	2.6%	0.0%	97
Electrospace Systems	71.1	9.2%	22.7%	81.4%	2.4%	9.3%	0.0%	161
Honeywell	68.9	0.2%	0.4%	67.4%	4.6%	5.2%	21.7%	12
Texas Instruments	64.4	0.8%	2.0%	72.6%	8.2%	9.0%	25.8%	13
Singer	62.6	3.3%	6.2%	79.7%	2.4%	5.2%	0.0%	41
Motorola	62.4	3.3%	5.7%	54.1%	8.4%	10.1%	38.2%	11
Tracor	60.2	3.0%	5.1%	72.8%	2.4%	5.7%	8.8%	76
Weighted average	**$75.2**	**2.9%**	**4.9%**	**69.1%**	**5.2%**	**7.5%**	**18.5%**	
DISTRIBUTORS								
Anthem Electronics	$394.5	3.0%	7.5%	77.0%	0.0%	0.7%	0.0%	198
Arrow Electronics	249.2	-5.3%	-17.9%	77.5%	0.0%	0.4%	0.0%	78
Marshall Industries	226.0	1.2%	2.9%	75.1%	0.0%	4.4%	0.0%	109
Pioneer-Standard	215.8	-1.0%	-2.4%	76.5%	0.0%	0.9%	0.0%	137
Ducommun	189.7	-4.2%	-9.3%	78.4%	0.0%	2.6%	0.0%	87
Wyle Laboratories	163.9	1.4%	4.8%	75.7%	0.0%	2.6%	0.0%	134
Avnet	153.0	1.7%	3.1%	73.5%	0.0%	1.6%	0.0%	47
Weighted average	**$181.7**	**-0.5%**	**-1.1%**	**75.5%**	**0.0%**	**1.8%**	**0.0%**	

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INDUSTRY SEGMENTS

Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	Rank
OFFICE EQUIPMENT								
Savin	$138.3	-3.1%	-10.2%	55.5%	1.7%	3.7%	0.0%	108
IBM	127.0	9.3%	12.0%	37.8%	7.8%	9.0%	50.5%	1
Xerox	93.2	5.2%	6.8%	42.8%	6.9%	11.0%	40.4%	6
Datapoint	89.8	-4.7%	-4.5%	42.6%	7.0%	8.1%	69.6%	98
Wang Laboratories	83.5	1.9%	2.3%	46.9%	7.7%	8.8%	39.7%	22
Harris	83.0	2.7%	5.4%	61.1%	5.3%	5.3%	6.9%	29
NCR	78.7	6.9%	13.0%	47.3%	6.6%	7.4%	43.8%	14
Diebold	77.8	8.4%	10.6%	62.5%	3.0%	3.6%	5.0%	94
Pitney Bowes	68.1	8.4%	14.3%	30.9%	2.7%	10.5%	17.3%	36
Weighted average	**$110.4**	**8.0%**	**10.7%**	**40.2%**	**7.3%**	**9.0%**	**45.7%**	
SOFTWARE								
Ultimate	$310.9	10.3%	20.5%	50.2%	0.0%	4.0%	16.9%	172
Lotus Development	199.1	17.1%	32.8%	14.3%	11.5%	5.5%	42.6%	106
Ashton-Tate	191.6	14.3%	22.9%	12.7%	9.2%	4.3%	28.2%	141
Mentor Graphics	190.9	6.3%	6.2%	50.7%	9.7%	5.9%	44.0%	164
Microsoft	171.3	19.9%	28.2%	17.8%	10.4%	7.1%	24.0%	114
UCCEL	107.3	12.2%	8.4%	19.6%	9.0%	8.3%	20.6%	188
Weighted average	**$180.4**	**14.0%**	**18.4%**	**25.1%**	**8.9%**	**5.8%**	**31.1%**	
CAPITAL EQUIPMENT								
Gerber Scientific	$112.8	9.5%	10.4%	44.3%	9.3%	3.7%	33.4%	139
Applied Materials	105.5	0.8%	1.0%	54.4%	16.5%	7.7%	53.5%	178
Computervision	103.6	-1.2%	-1.7%	46.9%	9.4%	5.0%	29.7%	79
GenRad	91.2	-14.6%	-16.7%	46.1%	17.6%	5.6%	42.4%	146
Perkin-Elmer	88.5	5.6%	7.5%	52.5%	8.1%	5.3%	39.1%	50
Hewlett-Packard	86.6	7.3%	10.9%	42.7%	11.6%	7.0%	46.3%	8
Fluke	83.6	5.8%	8.5%	41.3%	11.5%	4.3%	38.1%	143
Spectra-Physics	83.1	0.4%	0.5%	56.8%	8.5%	7.7%	48.1%	142
Tektronix	78.2	2.9%	4.2%	42.7%	14.6%	5.0%	38.8%	44
Varian Associates	76.8	-1.7%	-3.0%	68.6%	9.2%	5.6%	22.8%	56
Teradyne	71.2	0.1%	0.1%	48.9%	16.6%	9.9%	34.0%	100
Weighted average	**$85.6**	**4.9%**	**7.2%**	**46.3%**	**11.5%**	**6.4%**	**41.8%**	

For purposes of comparison, only companies whose electronics revenue constitutes over 70% of total revenue are included

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BEST AND WORST PERFORMERS

Five-year revenue growth

(Percentage change per year)

TOP 10	
AST Research	375.3%
MiniScribe	369.6%
Apollo Computer	158.4%
Ashton-Tate	125.1%
Seagate Technology	115.9%
Convergent Technologies	87.8%
Digital Communications	69.8%
Western Digital	63.5%
Du Pont	58.6%
Ultimate	55.4%

BOTTOM 5	
Singer	-8.3%
Union Carbide	-9.0%
Sun Chemical	-9.1%
Fairchild Industries	-12.6%
ITT	-15.2%

Revenue per employee

($ thousands)

TOP 10	
Emerson Radio	$821.9
Anthem Electronics	$394.5
Apple Computer	$339.6
Ultimate	$310.9
COMPAQ Computer	$284.2
Arrow Electronics	$249.2
Marshall Industries	$226.0
Dynascan	$215.9
Pioneer-Standard Electronics	$215.8
AST Research	$215.4

BOTTOM 5	
Advanced Micro Devices	$43.0
General Instrument	$38.7
AVX	$38.3
Applied Magnetics	$31.5
Sun Chemical	$23.7

Return on investment

(Percentage)

TOP 10	
Lotus Development	32.8%
SmithKline Beckman	31.8%
AST Research	31.0%
Microsoft	28.2%
Atari	23.3%
Ashton-Tate	22.9%
Electrospace Systems	22.7%
MiniScribe	22.3%
Cray Research	21.7%
Maxtor	21.1%

BOTTOM 5	
Arrow Electronics	-17.9%
Diasonics	-18.8%
Control Data	-20.0%
TIE/communications	-25.5%
Tandon	-101.4%

Five-year net income growth

(Percentage change per year)

TOP 10	
AST Research	377.0%
Digital Communications	207.4%
Micropolis	136.4%
Seagate Technology	82.9%
Ultimate	71.8%
Bolt Beranek and Newman	64.5%
Measurex	58.6%
Altos Computer Systems	53.5%
Intergraph	53.5%
Telex	52.9%

BOTTOM 5	
Teradyne	-44.5%
Honeywell	-45.0%
Esterline	-45.3%
Veeco Instruments	-48.2%
Intelligent Systems	-53.9%

Net income per employee

($ thousands)

TOP 10	
AST Research	$34.0
Lotus Development	$34.0
Microsoft	$34.0
Ultimate	$32.1
Cray Research	$31.2
Altos Computer Systems	$28.2
Ashton-Tate	$27.4
Digital Communications	$23.3
COMPAQ Computer	$19.5
Eli Lilly	$19.2

BOTTOM 5	
GenRad	-$13.3
CTS	-$13.8
Tandon	-$22.0
TIE/communications	-$34.9
LTV	-$67.3

Return on equity

(Percentage)

TOP 10	
Lotus Development	42.1%
SmithKline Beckman	40.2%
AST Research	31.4%
MiniScribe	30.6%
Ultimate	30.0%
Cray Research	28.2%
Microsoft	28.2%
Sun Electric	27.5%
Chrysler	26.3%
Electrospace Systems	26.0%

BOTTOM 5	
GenRad	-28.3%
Control Data	-31.0%
Ducommun	-36.2%
TIE/communications	-37.9%
Tandon	-122.7%

R&D

(Percentage of total revenue)

TOP 10	
Advanced Micro Devices	31.9%
Intel	18.0%
GenRad	17.6%
Monolithic Memories	17.2%
Teradyne	16.6%
Applied Materials	16.5%
DSC Communications	15.2%
National Semiconductor	15.0%
Cray Research	14.7%
Tektronix	14.6%

Capital expenditures

(Percentage of net cash flow after dividends)

TOP 10	
National Semiconductor	5,082.6%
Scientific-Atlanta	1,731.5%
General Instrument	653.7%
Intel	382.6%
Varian Associates	354.9%
Emhart	314.1%
M/A-COM	294.3%
United Technologies	257.8%
General Dynamics	255.6%
Coherent	253.2%

BOTTOM 5	
Kollmorgen	-170.5%
Convergent Technologies	-310.1%
Allen Group	-319.4%
Pioneer-Standard Electronics	-546.5%
Augat	-1,064.3%

Foreign revenue

(Percentage of total revenue)

TOP 10	
Datapoint	69.6%
Tandon	69.4%
Molex	63.5%
Cray Research	53.8%
Polaroid	53.6%
Applied Materials	53.5%
Atari	53.2%
Foxboro	51.2%
Measurex	51.0%
IBM	50.5%

FINANCIAL TABLES

Ranking: 1 - 50

Rank 1986	Rank 1985	Company	Calendar year: Electronics revenue ($ millions)	Calendar year: Total revenue ($ millions)	Calendar year: Net income ($ millions)	Fiscal year: Total revenue ($ millions)	Fiscal year: Net income ($ millions)	Return on equity	Return on investment
1	1	IBM	$51,250.0	$51,250.0	$4,789.0	$51,250.0	$4,789.0	13.9%	12.0%
2	2	AT&T	14,979.0	34,087.0	139.0	34,087.0	139.0	1.0%	0.6%
3	4	General Electric [1]	11,300.0	35,211.0	2,492.0	35,211.0	2,492.0	16.5%	11.7%
4	3	GM Hughes Electronics	10,440.0	10,440.0	445.1	10,440.0	445.1	6.7%	6.1%
5	6	DEC	8,414.3	8,414.3	861.6	7,590.4	617.4	10.8%	10.1%
6	5	Xerox	8,150.0	9,355.0	488.0	9,355.0	488.0	9.5%	6.8%
7	-	Unisys	7,432.4	7,432.4	-43.4	7,432.4	-43.4	-1.1%	-0.7%
8	9	Hewlett-Packard	7,245.0	7,245.0	523.0	7,102.0	516.0	11.8%	10.9%
9	23	Allied-Signal	6,132.9	11,794.0	605.0	11,794.0	605.0	16.4%	9.1%
10	35	Lockheed [2]	5,956.0	10,273.0	408.0	10,273.0	408.0	21.9%	11.8%
11	10	Motorola	5,888.0	5,888.0	194.0	5,888 0	194.0	7.0%	5.7%
12	8	Honeywell	5,378.2	5,378.2	12.9	5,378.2	12.9	0.6%	0.4%
13	13	Texas Instruments	4,974.0	4,974.0	39.9	4,974.0	39.9	2.3%	2.0%
14	15	NCR	4,466.7	4,881.6	336.5	4,881.6	336.5	14.0%	13.0%
15	16	Raytheon	4,343.0	7,308.0	393.2	7,308.0	393.2	20.1%	19.3%
16	18	Rockwell International	4,305.0	12,396.9	634.8	12,295.7	611.2	19.3%	15.7%
17	72	Eastman Kodak	3,850.0	11,550.0	374.0	11,550.0	374.0	5.9%	4.4%
18	20	North American Philips	3,440.0	4,531.6	68.5	4,531.6	68.5	6.2%	3.9%
19	21	Tandy	3,322.8	3,322.8	225.9	3,035.7	197.7	15.1%	11.8%
20	19	TRW	3,170.0	6,035.9	217.7	6,035.9	217.7	18.2%	9.3%
21	17	Control Data	2,682.8	3,346.7	-311.1	3,346.7	-311.1	-31.0%	-20.0%
22	25	Wang Laboratories	2,668.9	2,668.9	-86.4	2,642.5	50.9	3.5%	2.3%
23	22	Litton Industries	2,660.0	4,290.6	48.4	4,521.0	71.1	7.0%	5.6%
24	26	Westinghouse Electric	2,545.0	10,731.0	670.8	10,731.0	670.8	22.3%	16.3%
25	28	3M	2,460.0	8,602.0	779.0	8,602.0	779.0	17.5%	14.7%
26	29	Ford Motor	2,422.7	62,715.8	3,285.1	62,715.8	3,285.1	22.1%	18.0%
27	7	ITT	2,300.0	17,437.0	527.9	7,595.5	527.9	7.4%	5.2%
28	30	Martin Marietta	2,160.0	4,752.5	202.3	4,752.5	202.3	24.0%	18.8%
29	27	Harris	2,106.4	2,106.4	68.6	2,216.6	59.6	6.6%	5.4%
30	50	Grumman	2,075.0	3,440.1	78.7	3,440.1	78.7	10.3%	6.3%
31	34	Apple Computer	2,030.3	2,030.3	155.5	1,902.0	39.4	5.7%	5.7%
32	24	GTE	2,007.0	15,111.5	1,152.6	15,112.0	1,152.6	14.0%	6.5%
33	32	Boeing	1,975.0	16,341.0	665.0	16,341.0	665.0	13.8%	13.0%
34	36	Zenith Electronics	1,892.1	1,892.1	-10.0	1,892.1	-10.0	-2.3%	-1.2%
35	33	Eaton	1,800.0	3,811.6	137.6	3,811.6	137.6	10.9%	7.2%
36	38	Pitney Bowes	1,751.9	1,986.7	166.1	1,986.7	166.1	18.2%	14.3%
37	42	Du Pont	1,750.0	27,148.0	1,538.0	27,148.0	1,538.0	11.5%	8.4%
38	39	McDonnell Douglas	1,740.0	12,660.6	277.5	12,660.6	277.5	9.8%	7.2%
39	37	National Semiconductor	1,678.0	1,678.0	-57.0	1,478.1	-148.3	-20.7%	-17.5%
40	44	AMP	1,595.0	1,933.1	164.3	1,933.1	164.3	14.5%	12.4%
41	45	Singer	1,484.0	1,725.2	58.5	1,752.2	58.5	9.6%	6.2%
42	31	United Technologies	1,413.0	15,699.2	48.1	15,669.2	48.1	1.3%	0.8%
43	51	Teledyne	1,375.0	3,241.4	238.3	3,241.4	238.3	14.6%	10.8%
44	41	Tektronix	1,352.4	1,352.4	55.1	1,357.2	39.3	4.7%	4.2%
45	47	Emerson Electric	1,340.0	5,156.2	414.7	4,952.9	408.9	17.2%	14.2%
46	49	Data General	1,287.5	1,287.5	7.9	1,268.0	-29.0	-4.2%	-3.0%
47	48	Avnet	1,287.0	1,476.5	19.2	1,415.6	23.9	3.7%	3.1%
48	43	Intel	1,265.0	1,265.0	-183.3	1,265.0	-183.3	-14.4%	-10.9%
49	53	Northrop	1,247.9	5,608.4	41.2	5,608.4	41.2	4.6%	2.9%
50	46	Perkin-Elmer	1,182.0	1,303.4	62.1	1,290.6	72.6	10.3%	7.5%

[1] Includes RCA results from June 1, 1986

[2] Includes Sanders Associates results from July 28, 1986

Cost of goods as a percentage of revenue	Fiscal year: R&D as a percentage of revenue	Fiscal year: Revenue per employee ($ thousands)	Fiscal year: Net income per employee ($ thousands)	Five-year growth (Compounded annual growth rate): Revenue	Five-year growth (Compounded annual growth rate): Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
37.8%	7.8%	$127.0	$11.9	12.0%	7.7%	85.4%	14.0%	50.5%	12/86
42.0%	6.7%	107.6	0.4	NA	NA	135.3%	35.8%	0.0%	12/86
70.2%	3.7%	98.1	6.9	5.3%	8.6%	70.6%	29.0%	21.4%	12/86
74.1%	3.9%	102.4	4.4	NA	NA	115.4%	8.2%	12.2%	12/86
51.4%	10.7%	80.2	6.5	18.9%	12.5%	56.3%	5.8%	41.9%	6/86
42.8%	6.9%	93.2	4.9	1.5%	-4.0%	108.2%	28.4%	40.4%	12/86
62.9%	5.9%	77.4	-0.5	NA	NA	221.1%	41.8%	42.9%	12/86
42.7%	11.6%	86.6	6.3	15.0%	11.1%	63.9%	7.2%	46.3%	10/86
74.1%	3.9%	86.1	4.4	16.9%	10.0%	113.1%	44.7%	20.9%	12/86
85.1%	4.8%	106.0	4.2	14.7%	21.4%	79.6%	46.1%	6.3%	12/86
54.1%	8.4%	62.4	2.1	12.0%	2.1%	103.9%	18.9%	38.2%	12/86
67.4%	4.6%	68.9	0.2	0.1%	-45.0%	190.9%	39.3%	21.7%	12/86
72.6%	8.2%	64.4	0.5	3.4%	-18.1%	110.0%	13.6%	25.8%	12/86
47.3%	6.6%	78.7	5.4	7.3%	10.1%	68.7%	7.1%	43.8%	12/86
76.7%	3.5%	97.4	5.2	6.3%	4.0%	69.7%	4.0%	7.1%	12/86
76.1%	3.3%	101.6	5.1	11.8%	13.9%	54.5%	18.6%	13.6%	9/86
57.5%	9.2%	95.1	3.1	2.2%	-21.3%	180.2%	24.5%	35.9%	12/86
74.0%	2.5%	89.9	1.4	8.4%	-2.7%	159.4%	37.1%	0.0%	12/86
44.9%	0.0%	84.3	5.5	12.4%	3.1%	21.7%	22.0%	2.6%	6/86
73.2%	2.6%	73.2	2.6	2.7%	-1.0%	112.1%	48.8%	25.3%	12/86
61.7%	9.4%	97.3	-9.0	1.5%	NA	-140.4%	35.7%	32.5%	12/86
46.9%	7.7%	83.5	1.6	25.3%	-8.2%	92.8%	33.3%	39.7%	6/86
76.0%	2.6%	81.5	1.3	2.6%	-25.6%	130.0%	19.7%	20.0%	7/86
69.0%	2.3%	91.5	5.7	2.8%	8.9%	52.5%	27.0%	18.7%	12/86
53.1%	6.6%	105.1	9.5	5.7%	3.0%	76.3%	16.0%	37.4%	12/86
78.0%	3.7%	164.0	8.6	10.4%	NA	59.3%	18.8%	31.8%	12/86
79.0%	7.1%	61.8	4.3	-15.2%	-5.4%	53.4%	29.1%	39.3%	12/86
76.8%	4.6%	69.4	3.0	12.1%	0.2%	91.1%	21.5%	0.0%	12/86
61.1%	5.3%	83.0	2.2	9.3%	-10.8%	73.4%	18.9%	6.9%	6/86
89.5%	2.3%	103.0	2.4	14.0%	1.3%	161.8%	38.5%	0.0%	12/86
44.2%	6.7%	339.6	7.0	41.5%	-23.9%	73.6%	0.0%	25.8%	9/86
63.3%	1.9%	94.5	7.2	7.5%	10.9%	115.5%	53.8%	14.1%	12/86
85.0%	4.6%	137.9	5.6	10.8%	7.1%	84.4%	5.4%	44.9%	12/86
81.8%	5.3%	51.1	-0.3	8.2%	NA	203.3%	46.4%	12.0%	12/86
72.6%	3.5%	87.7	3.2	6.0%	1.5%	71.5%	34.5%	19.4%	12/86
30.9%	2.7%	68.1	5.7	3.8%	19.2%	88.0%	21.4%	17.3%	12/86
47.9%	4.3%	192.2	10.9	58.6%	12.7%	94.0%	27.0%	36.7%	12/86
79.5%	4.0%	119.8	2.6	11.4%	9.5%	109.7%	26.0%	22.2%	12/86
63.5%	15.0%	48.0	-4.8	5.9%	NA	5,082.6%	15.2%	37.9%	5/86
59.2%	8.8%	88.7	7.5	9.4%	4.0%	72.7%	14.4%	40.1%	12/86
79.7%	2.4%	62.6	2.1	-8.3%	8.8%	79.2%	35.4%	0.0%	12/86
75.9%	5.4%	81.0	0.2	4.4%	-36.3%	257.8%	39.5%	30.6%	12/86
75.1%	2.6%	72.4	5.3	0.0%	-10.4%	29.0%	26.0%	9.0%	12/86
42.7%	14.6%	78.2	2.3	5.0%	-13.3%	66.2%	10.3%	38.8%	5/86
61.5%	3.1%	81.6	6.7	7.6%	8.4%	41.0%	17.7%	17.4%	9/86
50.9%	11.3%	81.5	-1.9	11.5%	NA	203.8%	28.7%	36.4%	9/86
73.5%	0.0%	153.0	2.6	5.7%	-16.1%	75.4%	15.1%	0.0%	6/86
50.3%	18.0%	69.5	-10.1	9.9%	NA	382.6%	23.8%	39.9%	12/86
84.9%	6.7%	119.8	0.9	17.8%	50.1%	172.6%	37.2%	0.0%	12/86
52.5%	8.1%	88.5	5.0	3.0%	-1.5%	72.0%	26.7%	39.1%	7/86

FINANCIAL TABLES

Ranking: 51 - 100

Rank 1986	Rank 1985	Company	Calendar year: Electronics revenue ($ millions)	Calendar year: Total revenue ($ millions)	Calendar year: Net income ($ millions)	Fiscal year: Total revenue ($ millions)	Fiscal year: Net income ($ millions)	Return on equity	Return on investment
51	59	E-Systems	$1,008.8	$1,145.5	$61.6	$1,145.5	$61.6	16.3%	13.8%
52	56	Amdahl	966.3	966.3	39.3	966.3	39.3	7.9%	5.7%
53	40	Gould	908.8	908.8	34.6	908.8	34.6	6.2%	3.6%
54	65	Contel	900.0	3,074.0	232.9	3,074.0	232.6	15.3%	6.6%
55	68	General Dynamics	900.0	8,892.0	-62.6	8,892.0	-62.6	5.0%	-3.7%
56	52	Varian Associates	893.4	893.4	-8.8	891.1	-14.9	-3.6%	-3.0%
57	58	General Instrument	871.7	871.7	16.2	794.3	-66.5	-12.1%	-11.3%
58	60	Prime Computer	860.2	860.2	46.9	860.2	46.9	10.7%	10.3%
59	61	Chrysler	860.0	22,586.3	1,403.6	22,586.3	1,403.6	26.3%	17.8%
60	69	Tandem Computers	835.8	835.8	79.2	767.8	63.8	11.9%	11.7%
61	67	Johnson Controls	833.0	2,535.2	83.2	2,639.4	95.9	11.6%	9.0%
62	64	Telex	817.0	817.0	72.7	695.0	67.5	25.0%	16.4%
63	79	Emerson Radio	770.6	770.6	28.4	566.3	12.9	21.0%	8.3%
64	55	General Signal	754.3	1,583.4	74.6	1,583.4	74.9	8.1%	7.1%
65	63	Penn Central	730.0	2,387.9	154.2	2,387.9	154.2	7.4%	7.0%
66	100	Seagate Technology	709.5	709.5	90.4	459.8	34.5	16.6%	15.4%
67	66	Storage Technology	696.0	696.0	16.8	696.0	16.8	NA	NA
68	73	Loral	683.6	683.6	56.6	663.8	53.0	17.1%	12.0%
69	78	COMPAQ Computer	625.2	625.2	42.9	625.2	42.9	23.4%	16.7%
70	71	SmithKline Beckman	619.6	3,745.4	521.1	3,745.4	521.1	40.2%	31.8%
71	70	Advanced Micro Devices	615.2	615.2	-103.9	576.1	-36.6	-9.4%	-8.6%
72	76	Intergraph	605.7	605.7	70.4	605.7	70.4	14.2%	13.7%
73	88	Cray Research	596.7	596.7	124.8	596.7	124.8	28.2%	21.7%
74	74	Corning Glass Works	580.5	1,856.3	162.2	1,856.3	162.2	12.0%	9.5%
75	57	M/A-COM	577.6	577.6	-21.9	577.5	8.8	1.9%	1.4%
76	81	Tracor	577.0	632.1	18.8	632.1	18.8	8.8%	5.1%
77	77	Monsanto	540.0	6,879.0	433.0	6,879.0	433.0	11.5%	7.5%
78	80	Arrow Electronics	501.8	529.6	-28.3	529.6	-28.3	-27.6%	-17.9%
79	84	Computervision	494.7	494.7	-5.8	494.7	-5.8	-3.2%	-1.7%
80	75	SCI Systems	487.9	487.9	14.6	470.2	13.8	12.0%	7.0%
81	83	Scientific-Atlanta	479.6	479.6	-7.4	469.1	-9.2	-5.1%	-4.3%
82	82	United Telecommunications	460.3	3,058.8	187.2	3,058.8	187.2	10.7%	4.1%
83	-	Textron	445.0	5,023.3	241.6	5,023.3	241.6	13.1%	6.0%
84	124	Xidex	419.0	533.5	32.6	432.3	32.2	6.6%	5.5%
85	87	Medtronic	397.0	469.2	69.8	402.8	67.4	19.3%	16.9%
86	101	Apollo Computer	391.7	391.7	9.3	391.7	9.3	4.9%	3.0%
87	90	Ducommun	386.6	455.2	-19.2	455.2	-19.2	-36.2%	-9.3%
88	95	Tyler	384.3	961.4	11.9	961.4	11.9	6.6%	3.1%
89	122	Western Digital	352.8	352.8	32.4	279.4	21.5	22.8%	13.0%
90	89	Dataproducts	350.8	350.8	14.6	353.8	-26.8	-12.5%	-9.8%
91	110	Molex	349.4	349.4	38.9	291.9	32.0	12.6%	12.0%
92	85	Compugraphic	341.1	341.1	3.4	341.1	3.4	1.7%	1.5%
93	-	Sun Microsystems	341.1	341.1	24.5	210.1	11.9	11.0%	9.4%
94	94	Diebold	340.0	413.7	34.9	413.7	34.9	10.9%	10.6%
95	97	Analog Devices	336.1	336.1	20.2	334.4	23.4	8.7%	7.6%
96	91	EG&G	325.0	1,145.1	44.9	1,145.1	44.9	19.0%	15.2%
97	99	Cubic	318.0	344.9	2.5	337.8	1.1	1.0%	0.7%
98	93	Datapoint	317.3	317.3	-67.3	325.2	-15.4	-6.6%	-4.5%
99	143	AM International	317.0	959.7	0.7	688.9	2.4	1.0%	0.4%
100	92	Teradyne	306.1	306.1	0.2	306.1	0.2	0.1%	0.1%

Cost of goods as a percentage of revenue	Fiscal year: R&D as a percentage of revenue	Fiscal year: Revenue per employee ($ thousands)	Fiscal year: Net income per employee ($ thousands)	Five-year growth (Compounded annual growth rate): Revenue	Five-year growth (Compounded annual growth rate): Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
80.5%	0.0%	$76.4	$4.1	14.9%	20.9%	67.3%	15.4%	6.9%	12/86
50.7%	12.3%	134.2	5.5	16.9%	8.0%	100.4%	27.0%	43.5%	12/86
47.8%	10.8%	85.6	3.3	-4.4%	-11.0%	68.6%	41.2%	19.3%	12/86
32.3%	0.0%	133.1	10.1	12.8%	10.1%	128.5%	57.2%	0.0%	12/86
79.3%	3.0%	84.4	-0.6	13.9%	NA	255.6%	25.5%	0.0%	12/86
68.6%	9.2%	76.8	-1.3	7.3%	NA	354.9%	16.5%	22.8%	9/86
76.7%	5.2%	38.7	-3.2	-0.8%	NA	653.7%	6.4%	19.0%	2/86
40.1%	10.7%	99.8	5.4	18.7%	4.5%	83.1%	4.1%	47.2%	12/86
80.1%	3.2%	196.3	12.2	17.8%	NA	116.4%	32.2%	28.1%	12/86
26.7%	11.3%	134.3	11.1	29.8%	19.2%	60.8%	2.3%	39.6%	9/86
76.7%	1.5%	98.1	3.6	18.5%	14.8%	78.6%	22.2%	12.9%	9/86
51.0%	5.5%	94.1	9.1	30.1%	52.9%	98.3%	34.2%	15.6%	3/86
88.4%	0.1%	821.9	18.7	45.2%	NA	21.1%	60.5%	0.0%	3/86
66.6%	6.2%	79.2	3.7	-1.4%	-8.5%	54.5%	12.5%	11.4%	12/86
53.9%	1.4%	98.3	6.3	-6.5%	-1.8%	42.6%	4.7%	17.3%	12/86
76.2%	4.1%	51.7	3.9	115.9%	82.9%	71.9%	7.0%	36.7%	6/86
59.7%	8.9%	80.9	2.0	-5.5%	-27.2%	27.7%	NA	20.3%	12/86
81.5%	4.7%	81.0	6.5	22.8%	18.7%	65.7%	30.2%	0.0%	3/86
55.3%	4.3%	284.2	19.5	NA	NA	87.7%	28.4%	19.1%	12/86
30.9%	10.1%	111.0	15.4	10.2%	5.2%	45.4%	21.0%	34.9%	12/86
40.8%	31.9%	43.0	-2.7	13.2%	NA	179.7%	9.0%	23.9%	3/86
46.1%	9.5%	106.3	12.3	46.1%	53.5%	85.8%	3.7%	34.2%	12/86
24.5%	14.7%	149.2	31.2	42.5%	47.0%	65.7%	23.0%	53.8%	12/86
58.7%	5.6%	74.0	6.5	3.0%	10.7%	99.2%	20.7%	30.4%	12/86
63.0%	5.9%	64.0	1.0	3.1%	-27.4%	294.3%	30.1%	10.2%	9/86
72.8%	2.4%	60.2	1.8	11.2%	-0.2%	100.9%	41.8%	8.8%	12/86
51.8%	7.6%	133.0	8.4	-0.2%	-0.5%	51.3%	34.8%	32.6%	12/86
77.5%	0.0%	249.2	-13.3	8.0%	NA	-8.9%	35.0%	0.0%	12/86
46.9%	9.4%	103.6	-1.2	12.8%	NA	47.9%	46.4%	29.7%	12/86
92.6%	0.0%	90.7	2.7	51.3%	34.8%	49.7%	41.6%	21.1%	6/86
71.3%	5.9%	134.0	-2.6	11.1%	NA	1,731.5%	15.2%	16.0%	6/86
49.4%	0.4%	131.6	8.1	6.8%	-4.7%	176.0%	61.7%	0.0%	12/86
77.5%	2.1%	69.8	3.4	8.6%	9.7%	63.3%	54.5%	0.0%	12/86
65.1%	2.5%	66.5	5.0	42.6%	36.6%	80.9%	16.6%	24.7%	6/86
29.2%	9.6%	80.6	13.5	7.1%	10.8%	6.3%	12.8%	37.7%	4/86
46.4%	11.4%	109.5	2.6	158.4%	NA	110.3%	38.3%	47.8%	12/86
78.4%	0.0%	189.7	-8.0	21.5%	NA	-86.5%	74.5%	0.0%	12/86
74.0%	0.0%	127.8	1.6	13.1%	-10.5%	105.8%	52.2%	0.0%	12/86
58.7%	8.8%	113.2	8.7	63.5%	NA	47.2%	43.1%	33.0%	6/86
70.0%	8.8%	84.2	-6.4	4.2%	NA	-51.6%	21.7%	23.3%	3/86
45.3%	5.9%	66.3	7.3	15.3%	14.9%	69.6%	4.5%	63.5%	6/86
49.6%	11.3%	85.4	0.8	4.3%	NA	80.5%	15.0%	24.8%	12/86
45.9%	14.6%	103.4	5.9	NA	NA	206.4%	14.7%	20.5%	6/86
62.5%	3.0%	77.8	6.6	1.4%	3.8%	54.0%	2.4%	5.0%	12/86
36.8%	13.5%	67.4	4.7	16.4%	38.5%	71.0%	12.6%	47.3%	10/86
81.7%	1.4%	49.8	2.0	9.1%	5.0%	42.5%	20.2%	6.3%	12/86
77.9%	1.7%	75.1	0.3	8.2%	-36.7%	139.5%	32.2%	0.0%	9/86
42.6%	7.0%	89.8	-4.3	-3.9%	NA	122.6%	31.2%	69.6%	7/86
59.9%	3.0%	54.2	0.2	1.7%	NA	85.0%	56.7%	32.5%	7/86
48.9%	16.6%	71.2	0.1	13.9%	-44.5%	114.4%	6.6%	34.0%	12/86

FINANCIAL TABLES

Ranking: 101 - 150

Rank 1986	Rank 1985	Company	Calendar year: Electronics revenue ($ millions)	Calendar year: Total revenue ($ millions)	Calendar year: Net income ($ millions)	Fiscal year: Total revenue ($ millions)	Fiscal year: Net income ($ millions)	Return on equity	Return on investment
101	86	Convergent Technologies	$305.8	$305.8	-$32.8	$305.8	-$32.8	-14.9%	-13.7%
102	102	DSC Communications	304.0	304.0	11.0	304.0	11.0	5.5%	3.3%
103	96	TIE/communications	298.2	298.2	-59.3	298.2	-59.3	-37.9%	-25.5%
104	103	Foxboro	293.8	544.0	7.1	544.0	7.1	2.6%	2.3%
105	116	Dynatech	288.9	288.9	23.8	256.7	20.4	21.4%	17.7%
106	-	Lotus Development	282.9	282.9	48.3	282.9	48.3	42.1%	32.8%
107	106	Kollmorgen	278.0	319.2	-19.9	319.2	-19.9	-25.1%	-13.8%
108	98	Savin	272.0	362.7	-11.1	362.7	-11.1	11.8%	-10.2%
109	120	Marshall Industries	269.2	269.2	4.5	244.8	2.9	5.2%	2.9%
110	108	Premier Industrial	268.0	442.5	41.7	435.0	41.4	17.3%	16.7%
111	107	Dover	263.5	1,439.8	83.8	1,439.8	83.8	13.4%	10.6%
112	112	Paradyne	261.1	261.1	-38.5	261.1	-38.5	-26.3%	-0.5%
113	111	Augat	260.4	260.4	-8.7	260.4	-8.7	-4.4%	-3.6%
114	-	Microsoft	260.2	260.2	57.7	197.5	39.3	28.2%	28.2%
115	-	Atari	258.1	258.1	25.1	258.1	25.1	23.8%	23.3%
116	131	LTV	257.0	7,271.4	-3,251.6	7,271.4	-3,251.6	NA	NA
117	117	Bally Manufacturing	256.0	1,592.8	23.7	1,592.8	23.7	4.8%	1.3%
118	119	Watkins-Johnson	255.4	255.4	17.2	255.4	17.2	16.8%	13.3%
119	105	Emhart	255.0	2,094.3	-10.2	2,094.3	-10.2	-1.4%	-0.8%
120	145	Nashua	254.0	704.2	20.6	704.2	20.6	11.8%	9.3%
121	114	Square D	252.6	1,403.5	98.9	1,403.5	98.9	14.7%	11.6%
122	115	Union Carbide	248.0	6,343.0	130.0	6,343.0	130.0	12.9%	2.9%
123	125	Eli Lilly	247.0	3,702.4	558.2	3,720.4	558.2	20.4%	16.6%
124	147	Recognition Equipment	246.6	246.6	9.7	241.8	10.5	9.1%	6.0%
125	109	CTS	245.5	245.5	-26.6	245.5	-26.6	-22.8%	-16.0%
126	160	Polaroid	244.0	1,629.2	103.5	1,629.2	103.5	10.4%	8.9%
127	123	Tandon	242.8	242.8	-62.6	214.1	-62.8	-122.7%	-101.4%
128	136	Cincinnati Milacron	242.0	850.0	23.3	850.0	23.3	8.1%	4.6%
129	132	Figgie International	240.8	919.8	42.4	919.8	42.4	14.5%	10.4%
130	-	BRIntec	232.0	310.7	11.8	310.7	11.8	21.5%	8.6%
131	-	Wyse Technology	228.4	228.4	16.7	166.4	12.6	17.5%	15.5%
132	-	Reynolds & Reynolds	227.0	452.5	23.4	404.0	23.9	13.4%	9.2%
133	126	Cooper Industries	226.0	3,433.3	147.7	3,433.3	147.7	10.4%	6.2%
134	138	Wyle Laboratories	224.6	307.0	4.3	307.0	4.3	5.3%	4.8%
135	150	Sundstrand	220.0	1,433.9	45.4	1,433.9	45.4	7.5%	4.9%
136	164	Diasonics	217.1	217.1	-17.4	217.1	-17.4	-22.7%	-18.8%
137	135	Pioneer-Standard	214.2	214.2	-0.4	202.0	-2.1	-7.0%	-2.4%
138	-	Micropolis	213.1	213.1	18.3	213.1	18.3	16.5%	16.5%
139	134	Gerber Scientific	213.0	213.0	19.7	191.8	18.2	12.9%	10.4%
140	154	Monolithic Memories	213.0	213.0	9.9	204.9	8.9	4.0%	3.8%
141	-	Ashton-Tate	210.8	210.8	30.1	210.8	30.1	24.6%	22.9%
142	137	Spectra-Physics	208.8	208.8	0.9	210.1	0.8	0.6%	0.5%
143	130	Fluke	208.5	208.5	11.6	209.0	12.2	9.8%	8.5%
144	140	Avantek	208.2	208.2	16.1	208.2	16.1	10.9%	10.9%
145	142	Logicon	204.5	204.5	9.3	198.4	10.0	19.1%	19.1%
146	127	GenRad	204.3	204.3	-29.9	204.3	-29.9	-28.3%	-16.7%
147	133	Andrew	198.0	198.0	9.5	197.7	9.5	6.6%	5.7%
148	-	Bolt Beranek and Newman	196.6	196.6	12.9	178.0	11.3	14.4%	13.4%
149	148	AVX	195.4	195.4	-3.1	195.4	-3.1	-2.0%	-1.5%
150	152	Decision Industries	195.1	195.1	7.8	195.1	7.8	8.0%	7.8%

Cost of goods as a percentage of revenue	Fiscal year: R&D as a percentage of revenue	Fiscal year: Revenue per employee ($ thousands)	Fiscal year: Net income per employee ($ thousands)	Five-year growth (Compounded annual growth rate): Revenue	Five-year growth (Compounded annual growth rate): Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
68.3%	10.7%	$124.2	-$13.3	87.8%	NA	-310.1%	8.2%	14.0%	12/86
51.8%	15.2%	128.5	4.7	53.5%	NA	51.7%	40.3%	0.0%	12/86
73.9%	7.7%	175.4	-34.9	17.9%	NA	-5.4%	32.8%	25.7%	12/86
57.6%	8.6%	69.3	0.9	-2.2%	-30.9%	84.3%	9.5%	51.2%	12/86
40.9%	8.6%	100.7	8.0	25.1%	30.8%	43.9%	17.4%	22.9%	3/86
14.3%	11.5%	199.1	34.0	NA	NA	25.4%	22.2%	42.6%	12/86
72.9%	5.2%	77.8	-4.9	7.3%	NA	-170.5%	45.1%	7.7%	12/86
55.5%	1.7%	138.3	-4.2	-4.8%	NA	78.7%	186.9%	0.0%	12/86
75.1%	0.0%	226.0	2.6	15.7%	NA	223.4%	44.0%	0.0%	5/86
52.3%	0.6%	120.8	11.5	6.5%	5.0%	16.2%	3.2%	0.0%	5/86
67.5%	3.0%	87.1	5.1	7.0%	-2.7%	33.5%	20.6%	14.6%	12/86
60.7%	7.4%	75.5	-11.1	14.0%	NA	-165.1%	98.0%	11.0%	12/86
70.1%	6.4%	70.3	-2.4	5.1%	NA	-1,064.3%	19.5%	18.5%	12/86
17.8%	10.4%	171.3	34.0	NA	NA	31.3%	0.0%	24.0%	6/86
57.3%	5.6%	184.4	17.9	NA	NA	3.3%	1.9%	53.2%	12/86
86.1%	NA	150.5	-67.3	0.6%	NA	-5.8%	-8.9%	0.0%	12/86
67.3%	1.0%	75.4	1.1	12.9%	-21.9%	115.2%	72.7%	0.0%	12/86
59.3%	6.4%	81.1	5.5	14.0%	20.9%	56.7%	20.8%	14.2%	12/86
63.5%	2.1%	61.3	-0.3	3.7%	NA	314.1%	40.8%	45.8%	12/86
65.0%	1.0%	121.4	3.6	3.3%	NA	45.3%	21.3%	42.6%	12/86
62.6%	3.0%	68.5	4.8	4.9%	-1.3%	86.6%	21.3%	17.3%	12/86
61.3%	2.3%	126.1	2.6	-9.0%	-27.5%	119.4%	77.8%	28.2%	12/86
31.4%	11.5%	127.8	19.2	6.1%	8.3%	58.4%	18.6%	34.7%	12/86
56.4%	4.8%	82.0	3.6	13.0%	NA	59.1%	34.4%	46.0%	10/86
77.2%	0.0%	127.6	-13.8	5.7%	NA	-156.8%	29.9%	17.2%	12/86
52.2%	7.8%	110.3	7.0	2.8%	27.2%	57.7%	14.7%	53.6%	12/86
86.3%	7.9%	75.1	-22.0	31.6%	NA	-17.0%	17.4%	69.4%	9/86
74.1%	4.7%	88.6	2.4	-1.9%	-17.4%	85.0%	42.8%	29.9%	12/86
74.3%	1.7%	56.4	2.6	4.8%	11.7%	53.2%	28.0%	0.0%	12/86
72.7%	1.9%	70.6	2.7	3.6%	NA	39.3%	59.8%	12.4%	12/86
64.8%	5.4%	118.6	9.0	NA	NA	61.2%	11.4%	13.5%	3/86
49.4%	0.0%	74.4	4.4	9.7%	22.8%	48.9%	31.3%	8.7%	9/86
63.3%	0.8%	85.4	3.7	3.7%	-9.3%	55.4%	40.1%	20.6%	12/86
75.7%	0.0%	163.9	2.3	7.9%	22.0%	136.0%	10.3%	0.0%	1/87
61.1%	4.6%	89.6	2.8	6.5%	-13.7%	144.1%	34.4%	23.1%	12/86
58.7%	6.3%	157.0	-12.6	23.5%	NA	-79.1%	17.1%	26.0%	12/86
76.5%	0.0%	215.8	-2.2	17.1%	NA	-546.5%	66.2%	0.0%	3/86
71.8%	5.2%	118.9	10.2	54.9%	136.4%	60.7%	0.0%	17.7%	12/86
44.3%	9.3%	112.8	10.7	15.5%	16.4%	31.6%	19.0%	33.4%	4/86
44.9%	17.2%	48.8	2.1	21.8%	5.0%	87.8%	4.4%	26.2%	9/86
12.7%	9.2%	191.6	27.4	125.1%	NA	21.6%	7.0%	28.2%	1/87
56.8%	8.5%	83.1	0.3	9.1%	-19.6%	155.2%	19.9%	48.1%	9/86
41.3%	11.5%	83.6	4.9	8.4%	7.5%	41.8%	13.3%	38.1%	9/86
50.5%	12.2%	67.0	5.2	20.5%	11.1%	71.7%	0.1%	14.0%	12/86
83.2%	0.5%	80.8	4.1	21.0%	29.8%	32.8%	0.0%	0.0%	3/86
46.1%	17.6%	91.2	-13.3	3.8%	NA	-84.6%	40.9%	42.4%	12/86
62.0%	6.7%	84.8	4.1	11.6%	-0.7%	47.6%	14.0%	32.3%	9/86
55.9%	4.8%	84.3	5.4	26.5%	64.5%	88.1%	7.1%	0.0%	6/86
72.3%	2.8%	38.3	-0.6	9.8%	NA	83.1%	27.2%	34.7%	12/86
61.9%	5.2%	121.9	4.8	31.2%	30.4%	53.3%	3.0%	27.0%	11/86

FINANCIAL TABLES

Ranking: 151 - 200

Rank 1986	Rank 1985	Company	Calendar year: Electronics revenue ($ millions)	Calendar year: Total revenue ($ millions)	Calendar year: Net income ($ millions)	Fiscal year: Total revenue ($ millions)	Fiscal year: Net income ($ millions)	Return on equity	Return on investment
151	176	LSI Logic	$194.3	$194.3	$3.9	$194.3	$3.9	1.5%	1.1%
152	151	Measurex	192.7	192.7	21.1	192.7	21.1	13.9%	13.3%
153	144	Bell Industries	192.0	319.1	3.2	300.2	3.0	2.9%	2.5%
154	139	Micom Systems	191.6	191.6	9.5	189.5	10.8	6.8%	6.4%
155	128	Bell & Howell	190.0	853.4	32.9	853.4	32.9	12.1%	7.0%
156	146	General DataComm	189.2	189.2	3.9	178.0	3.9	4.6%	2.6%
157	141	Ball	187.5	1,070.3	58.9	1,070.3	58.9	16.1%	12.0%
158	-	MiniScribe	184.9	184.9	20.3	184.9	20.3	30.6%	22.3%
159	121	NBI	181.0	283.1	-10.4	282.4	-3.9	-3.6%	-2.1%
160	167	Cipher Data Products	180.8	180.8	7.5	163.0	7.2	5.4%	5.4%
161	187	Electrospace Systems	179.9	179.9	10.0	145.0	13.4	26.0%	22.7%
162	166	Kidde	175.0	2,356.2	52.2	2,356.2	52.2	7.2%	4.2%
163	162	ADT	174.3	519.2	22.3	519.2	22.3	16.2%	11.8%
164	180	Mentor Graphics	173.5	173.5	11.0	173.5	11.0	7.1%	6.2%
165	161	Allen Group	173.0	423.2	-8.6	423.2	-8.6	-5.8%	-4.1%
166	170	Veeco Instruments	170.7	170.7	0.5	167.8	0.4	0.4%	0.3%
167	-	Ametek	170.0	568.5	36.6	568.4	36.6	15.8%	9.4%
168	155	AST Research	168.9	168.9	17.3	172.3	27.2	31.4%	31.0%
169	179	Sun Electric	167.0	186.0	2.5	177.0	1.9	27.5%	3.4%
170	189	Analogic	166.5	166.5	17.3	148.2	10.1	6.4%	5.9%
171	163	Tyco Laboratories	166.0	1,037.6	42.6	796.4	37.5	17.8%	9.5%
172	-	Ultimate	163.0	163.0	13.9	139.9	14.4	30.0%	20.5%
173	158	ISC Systems	162.4	162.4	10.8	166.1	13.9	14.7%	12.0%
174	-	Genicom	157.5	157.5	8.6	157.5	8.6	18.9%	12.9%
175	-	Data Card	157.0	182.5	2.1	153.6	10.6	13.7%	12.5%
176	-	Digital Communications	156.9	156.9	22.9	137.9	20.6	17.3%	17.3%
177	174	International Rectifier	151.7	151.7	0.2	145.2	-1.8	-3.1%	-1.1%
178	159	Applied Materials	151.5	151.5	-0.5	149.3	1.2	1.3%	1.0%
179	173	Esterline	151.0	233.6	0.6	235.9	0.9	0.9%	0.6%
180	-	Mark IV Industries	151.0	244.8	9.1	259.8	6.3	21.6%	3.5%
181	169	Becton, Dickinson & Co.	150.0	1,389.7	124.8	1,311.6	111.9	13.9%	8.3%
182	157	Unitrode	149.4	149.4	-7.0	149.4	-7.0	-5.6%	-5.2%
183	193	Dynascan	146.8	146.8	6.1	146.8	6.1	16.2%	8.2%
184	-	Maxtor	147.9	147.9	22.2	85.2	10.7	23.3%	21.1%
185	175	Mark Controls	145.0	262.7	1.5	262.7	1.5	3.2%	2.3%
186	-	ADC Telecommunications	144.9	144.9	11.4	143.7	12.0	19.8%	18.7%
187	-	Intelligent Systems	143.5	143.5	1.8	125.5	0.0	0.1%	0.1%
188	-	UCCEL	141.6	141.6	17.2	141.6	17.2	13.3%	8.4%
189	195	Burndy	140.0	242.1	9.5	242.1	9.5	6.9%	4.9%
190	153	Pittway	140.0	585.7	27.6	585.7	27.6	9.8%	8.5%
191	-	Sun Chemical	140.0	371.4	26.1	371.4	26.1	4.1%	2.7%
192	190	Altos Computer Systems	139.5	139.5	19.1	134.2	20.3	19.8%	18.7%
193	181	Coherent	138.4	138.4	-0.2	138.2	-0.9	-1.1%	-0.8%
194	-	Applied Magnetics	137.0	137.0	4.4	128.1	4.1	4.1%	4.0%
195	185	United Industrial	137.0	272.5	-9.2	272.5	-9.2	-9.8%	-7.3%
196	188	Aydin	136.8	136.8	7.0	136.8	7.0	11.6%	10.7%
197	177	Fairchild Industries	134.0	643.3	7.6	643.3	7.6	4.1%	2.2%
198	-	Anthem Electronics	132.7	132.7	2.8	104.5	3.1	7.5%	7.5%
199	-	Olin	132.0	1,707.3	75.2	1,707.3	75.2	11.5%	7.0%
200	-	Thomas & Betts	132.0	347.4	38.0	347.4	38.0	15.5%	13.6%

Cost of goods as a percentage of revenue	Fiscal year: R&D as a percentage of revenue	Fiscal year: Revenue per employee ($ thousands)	Fiscal year: Net income per employee ($ thousands)	Five-year growth (Compounded annual growth rate): Revenue	Five-year growth (Compounded annual growth rate): Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
50.4%	11.1%	$106.7	$2.1	NA	NA	200.5%	30.2%	21.2%	12/86
51.3%	7.3%	77.4	8.5	10.0%	58.6%	28.7%	4.1%	51.0%	11/86
74.5%	0.0%	158.0	1.6	9.5%	-18.0%	162.7%	11.7%	0.0%	6/86
44.8%	8.4%	93.3	5.3	39.1%	20.7%	44.1%	6.0%	27.7%	3/86
58.4%	5.1%	72.8	2.8	4.0%	13.7%	69.7%	42.2%	25.4%	12/86
55.9%	11.0%	70.7	1.6	25.3%	16.4%	131.3%	44.7%	23.2%	9/85
77.4%	1.6%	118.9	6.5	5.6%	15.0%	89.4%	25.3%	0.0%	12/86
71.1%	4.6%	NA	NA	369.6%	NA	79.0%	27.2%	22.0%	12/86
51.6%	4.4%	86.3	-1.2	37.4%	NA	128.5%	41.6%	6.5%	6/86
63.4%	9.2%	65.6	2.9	47.4%	NA	56.4%	0.0%	30.9%	6/86
81.4%	2.4%	71.1	6.6	26.1%	36.7%	85.0%	12.8%	0.0%	3/86
71.9%	0.9%	62.0	1.4	3.0%	-12.1%	88.8%	41.9%	10.7%	12/86
61.6%	1.2%	56.3	2.4	6.2%	-2.2%	139.8%	27.1%	17.3%	12/86
50.7%	9.7%	190.9	12.1	NA	NA	52.3%	11.8%	44.0%	12/86
66.7%	0.0%	78.4	-1.6	9.4%	NA	-319.4%	28.9%	37.9%	12/86
59.9%	7.4%	67.1	0.2	8.6%	-48.2%	247.7%	18.1%	44.0%	9/86
72.2%	4.0%	90.2	5.8	4.9%	6.7%	58.5%	40.6%	10.7%	12/86
42.5%	4.9%	215.4	34.0	375.3%	377.0%	21.2%	1.1%	27.8%	6/86
53.3%	3.2%	70.6	0.8	0.0%	NA	48.3%	87.6%	31.5%	10/86
51.3%	12.4%	80.1	5.4	11.5%	3.9%	45.9%	8.4%	42.4%	7/86
75.7%	0.9%	79.6	3.8	17.2%	10.7%	50.8%	47.0%	6.0%	5/86
50.2%	0.0%	310.9	32.1	55.4%	71.8%	29.8%	31.6%	16.9%	4/86
49.5%	9.0%	90.2	7.5	38.7%	25.5%	34.8%	18.1%	0.0%	6/86
61.6%	3.9%	63.0	3.4	NA	NA	30.8%	31.5%	20.1%	12/86
54.3%	5.8%	79.5	5.5	16.3%	12.5%	75.0%	8.4%	28.8%	3/86
30.7%	11.3%	156.1	23.3	69.8%	207.4%	33.9%	0.0%	17.3%	6/86
66.2%	6.4%	63.1	-0.8	10.1%	NA	186.2%	65.9%	46.4%	6/86
54.4%	16.5%	105.5	0.9	13.5%	-21.9%	128.2%	23.4%	53.5%	10/86
60.5%	4.8%	75.4	0.3	1.1%	-45.3%	142.9%	34.9%	37.7%	10/86
63.4%	2.5%	65.0	1.6	NA	NA	18.0%	83.8%	0.0%	2/1/86
47.8%	5.4%	68.0	5.8	4.2%	8.1%	92.7%	40.5%	28.9%	9/86
58.3%	8.2%	55.2	-2.6	4.8%	NA	249.4%	8.1%	20.0%	1/87
71.5%	1.6%	215.9	8.9	17.1%	14.9%	26.0%	49.6%	5.1%	12/86
65.8%	7.0%	87.1	10.9	NA	NA	61.2%	9.6%	25.2%	3/86
66.5%	1.7%	98.1	0.6	-0.9%	-20.7%	65.8%	29.3%	0.0%	12/86
46.6%	9.0%	83.1	6.9	25.3%	31.8%	53.3%	5.7%	10.4%	10/86
62.7%	4.6%	194.6	0.1	46.2%	-53.9%	97.5%	27.1%	20.1%	3/86
19.6%	9.0%	107.3	13.0	-0.6%	12.2%	41.5%	36.7%	20.6%	12/86
60.9%	3.9%	63.1	2.5	-1.2%	-22.1%	33.8%	29.8%	42.0%	12/86
59.7%	0.0%	81.4	3.8	7.7%	-4.3%	104.4%	13.5%	16.0%	12/86
70.0%	3.0%	23.7	1.7	-9.1%	-5.7%	54.4%	34.5%	24.6%	12/86
57.9%	8.0%	186.9	28.2	44.4%	53.5%	11.0%	5.6%	35.0%	6/86
61.6%	10.7%	99.3	-0.6	14.7%	NA	253.2%	23.4%	42.7%	9/86
65.4%	13.2%	31.5	1.0	13.6%	-6.7%	80.8%	1.5%	33.9%	9/86
89.6%	1.3%	67.3	-2.3	12.7%	NA	-99.6%	25.4%	4.4%	12/86
62.8%	5.5%	68.4	3.5	6.4%	1.9%	22.2%	7.7%	28.1%	12/86
73.1%	1.7%	57.4	0.7	-12.6%	-33.5%	130.7%	47.9%	7.3%	12/86
77.0%	0.0%	394.5	11.9	23.6%	7.4%	21.9%	0.0%	0.0%	3/86
70.7%	3.3%	129.3	5.7	-0.3%	-0.4%	84.4%	39.5%	6.1%	12/86
44.6%	4.8%	108.6	11.9	37.7%	32.3%	79.6%	12.3%	37.9%	12/86

The billion-dollar club

Fifty-one companies now belong to the ranks of those having more than $1 billion in electronics sales

IBM

1 IBM is the electronics industry personified. When the Armonk, N.Y., giant reported declines in earnings quarter after quarter last year, and a 26.9% drop for the total year, the world shuddered. No other indicator was needed to prove that the entire industry was in a serious slump.

In addition to slow capital spending, IBM reported unsatisfactory levels of demand for parts of its product line last year. And while the monolith has yet to enjoy an upswing in sales that some of its closest competitors have experienced, 1987 got off with a Big Blue bang.

First quarter results were better than expected. Sales of its 3090 mainframe computers reportedly have picked up. IBM's new midrange offering, the 9370 Information System, promises to fill the company's weakest product gap this year. And Big Blue's next generation personal computer, the Personal System/2, announced in a gala event that spanned the East Coast from Miami to Boston, has thrust IBM, after a low-profile year, back onto center stage.

AT&T

2 Chairman James E. Olson has two words to describe his top priority at AT&T: improve earnings. Indeed, AT&T's net income of $139 million on revenue of $34 billion last year was nothing to phone home about.

The company's finances should look better this year. In a major expense-slashing program, Olson reduced AT&T's workforce by 32,000 employees as he took a $3.2 billion write-off late last year to account for the job cuts and other consolidations within the corporation. The cuts will save AT&T $1 billion this year and $1.4 billion next year, according to Olson, who became chairman last September.

But the company is not cutting back in two important areas. According to Olson, AT&T will spend $3.9 billion on capital investment this year, up from $3.6 billion last year. And the company will also spend $2.4 billion on research and development this year, up 5.3% from last year. Said Olson: "As urgent as our financial objectives are, we are not after the quick, the cosmetic fix."

One of the major reasons for AT&T's recent [illegible]es has been an inability to succeed in the computer market place. The company, last year, reportedly lost $1.2 billion trying to compete against industry doyens IBM and Digital Equipment Corp. Olson, however, is not giving up. His new plan: leverage AT&T's phone expertise by selling computer and communication equipment as unified "data networking" systems. According to Vittorio Cassoni, a senior vice president in charge of AT&T's Data Systems Division, the company's computer business should turn a profit within the next two years.

continued...

ALPHABETICAL INDEX TO THE BILLION-DOLLAR CLUB

Company	Rank
Allied-Signal Inc.	9
AMP Inc.	40
Apple Computer Inc.	31
AT&T	2
Avnet Inc.	47
Boeing Co., The	33
Control Data Corp.	21
Data General Corp.	46
Digital Equipment Corp.	5
Du Pont de Nemours and Co., E.I.	37
Eastman Kodak Co.	17
Eaton Corp.	35
Emerson Electric Co.	45
E-Systems Inc.	51
Ford Motor Co.	26
General Electric Co.	3
GM Hughes Electronics Corp.	4
Grumman Corp.	30
GTE Corp.	32
Harris Corp.	29
Hewlett-Packard Co.	8
Honeywell Inc.	12
IBM Corp.	1
Intel Corp.	48
ITT Corp.	27
Litton Industries Inc.	23
Lockheed Corp.	10
Martin Marietta Corp.	28
McDonnell Douglas Corp.	38
Minnesota Mining & Manufacturing Co.	25
Motorola Inc.	11
NCR Corp.	14
National Semiconductor Corp.	39
North American Philips Corp.	18
Northrop Corp.	49
Perkin-Elmer Corp., The	50
Pitney Bowes Inc.	36
Raytheon Co.	15
Rockwell International Corp.	16
Singer Co., The	41
Tandy Corp.	19
Tektronix Inc.	44
Teledyne Inc.	43
Texas Instruments Inc.	13
TRW Inc.	20
Unisys Corp.	7
United Technologies Corp.	42
Wang Laboratories Inc.	22
Westinghouse Electric Corp.	24
Xerox Corp.	6
Zenith Electronics Corp.	34

General Electric

3 For an already diversified electronics company, 1986 proved to be a year of further diversification for General Electric. In June, the Fairfield, Conn., company acquired RCA Corp., which added network television, carpet and records to GE's already long list of businesses.

In its key technology businesses — aircraft engine, aerospace, plastics, medical systems and factory automation — earnings have grown 26% annually since 1981. In factory automation, last year GE formed a 50-50 joint venture with Fanuc of Japan, called GE Fanuc Automation Corp. GE and RCA's combined communications business equals nearly $2 billion in sales. In 1986, reports GE, 70% of the company's net earnings were in its technology and service businesses, compared with 50% five years ago.

Being diversified isn't always easy, however. While GE's technology businesses grow, the company is faced with continued slowdown in its power systems, motor, construction equipment and transportation systems businesses. But by 1991, reports GE, NBC, and its recent financial services acquisition, Kidder, Peabody & Company Inc., in addition to its major appliances and technology businesses, should account for 80% of net earnings.

GM Hughes

4 In its first full year of operations as a General Motors Corp. company, GM Hughes Electronics Corp. increased revenue nearly 10%, to $10.4 billion, and pushed earnings up 22%, to $594 million. Despite a slowdown in defense spending, sales at Hughes Aircraft Co., a division of GMHE, were up 11%, to $6.9 billion. And despite a 10% decline in GM auto production, sales at the company's Delco Electronics Corp., which sells automotive electronics, rose 6%, to $3.5 billion.

While speculations about GM's influence over its newly acquired Hughes division flew, last year was calmer for both the aircraft company and the auto maker than the previous year. On Dec. 31, 1985, GM bought Hughes Aircraft Co. for $5.2 billion, thereby forcing the ouster, from GM's board, of H. Ross Perot, who voted against the acquisition.

But the action may pick up again this year. Allen E. Puckett, chairman and chief executive at Hughes Aircraft, retired and was replaced by Albert D. Wheelon, former executive vice president at the aerospace concern. In other management shuffles, seven other veterans were promoted. Meanwhile, the outlook for both defense spending and automotive sales remains moderate. But GMHE will be one year older and its parent perhaps a little less patient.

DEC

5 Perhaps once every decade, a major IBM rival makes a serious challenge to IBM's industry dominance. In plumping itself up from roughly one-seventh to roughly one-fifth the size of IBM in the last two years, Digital Equipment Corp. has joined that elite.

Developing DEC Doomsday scenarios, of course, is becoming fashionable. New IBM product announcements, for example, are colorfully described as VAX killers. Unix, Japan's Trojan horse for penetrating the U.S. market, is also touted as a threat to proprietary operating systems like DEC's VMS. But the most common Doomsday scenario is that DEC will be squeezed between two new classes of supersystems: supermicros and minisupers. This recalls the off-target Doomsday scenario of the early 1980s which held that DEC's superminicomputers would be crunched between microcomputers and mainframes. DEC has enough time and more than enough resources to invalidate the new Doomsday scenario.

DEC will wait for the optimal moment to introduce VAX implementations competitive with both supermicros and minisupers. Two papers delivered at the International Solid State Conference early this year report a 2-micron VLSI chip set for parallel processing and a 135,000 transistor CMOS VAX microprocessor with on-chip instruction and data cache. Precedent indicates these should be deliverable within a year. Although DEC will eventually be forced by its challengers into dramatic price/performance breakthroughs that will cut deeply into margins, DEC should have the technology reservoir to beat back challengers. The company, after all, has spent $2 billion on R&D in the last three years.

Xerox

6 Xerox Corp. is taking one last swipe at the office automation market by playing off its printed-word heritage and latching onto the electronic publishing fad. Xerox, of course, already has a huge presence in the office, and its copier business is holding strong in the face of Japanese competition.

Financial performance suffered last year, as Xerox shed the last of Shugart and Century Data Systems. The company also dumped some publishing units and bought a piece of systems integrator Federal Data Corp. to help out on government bids.

As usual, Xerox must figure out what to do with all of the wonderful technology that comes out of its Palo Alto, Calif., labs. This is the company that is credited with inventing the workstation and the Macintosh, yet capitalized on neither. It must manage its computer tangle — adopting DEC minis and reportedly switching PC suppliers, while getting its own workstation off the ground.

Unisys

7 For W. Michael Blumenthal, chairman and chief executive of Unisys Corp., his dream finally came true last year. Burroughs Corp. and Sperry Corp., two of the oldest hands at the computer industry, were merged into a $7.4 billion giant. By year-end, Blumenthal's merger had a new name, new management and new structure to give the combined companies a new, sleeker look.

Nearly $2 billion in assets, including portions of Burrough's Memorex subsidiary and Sperry's aerospace operations, were divested. Sales and marketing were consolidated and reorganized around vertical, target markets such as the financial services, manufacturing and airline industries. Product lines from both companies were upgraded and supported.

Now that the reorganization has been completed, ahead of schedule according to Blumenthal, 1987 will be the year Unisys has to prove itself. If Blumenthal's dream is to continue, Unisys, no longer two separate but equal companies, must learn to move as one. And become the powerhouse that Blumenthal envisioned.

continued...

Hewlett-Packard

8 Hewlett-Packard Co. is really two electronics companies: a $4 billion California computer company and a $2 billion Colorado instruments company. Both sides of the house have been looking to get its profit margin back to the 9% to 10% range.

In computers, the big news was the shipment of HP's first RISC architecture machine. HP is slowly but surely moving into reduced-instruction set computers across its business, manufacturing, and technical computer lines. The company faces a tricky double-balancing act in keeping its installed base of software operable on RISC and shifting to Unix in technical computing. A sign of success — HP emerged as a strong contender as the No. 1 workstation vendor, selling some $400 million worth of machines in that high-growth market.

In instruments, HP continued its dominance of a sluggish industry. Broaching the two businesses is HP's effort in CIM, for computer-integrated manufacturing. Even more than IBM, HP has the right to claim the most hooks to tie design, engineering, manufacturing and sales together in the company of the future. Whether customers really want that connection from one supplier is HP's big challenge.

Allied-Signal

9 Don't look for Allied-Signal Inc. in the top two dozen of next year's ELECTRONIC BUSINESS 200. Last year, the aerospace, automotive and materials conglomerate decided it could do better without the Electronics and Instrumentation sector that last year yielded 12% of its $11.8 billion sales.

So this spring, the corporation, with an apparent passion for sell-offs and acquisitions, began offloading audio unit Ampex Corp., connector maker Amphenol Corp. and others, in sales that will reap over $1 billion.

Allied-Signal is still rich in electronics — its Bendix unit is a talented aerospace player. But the spring sale cuts aerospace's contribution to total revenue from 52% for fiscal 1986 to 44% now. And it further postpones Allied's goal of being revered as a high-tech force, not just a collection of bits and pieces.

Lockheed

10 Lockheed Corp. had a good year in 1986, with sales increasing 8% over 1985 figures. The company does 87% of its business with the U.S. government and it is divided into four major areas: missiles, space and electronics systems; aeronautical systems; information systems; and marine systems.

The missiles, space and electronics systems area is primary for Lockheed, and was significantly augmented in 1986 by the acquisition of Sanders Associates, a manufacturer of electronic countermeasure devices, signal processors, automatic test equipment and advanced electronic components. Despite the slow or no-growth status of the federal budget, Lockheed expects the defense electronics market to continue to outpace the budget. Electronics represent 35% of defense procurement, rising to over 40% during the next 10 years. Thanks to Sanders, Lockheed is well positioned to leverage that growth.

Another fast growing area for Lockheed is its Information Systems divison, which grew 100% from 1985 to 1986, due in part to the acquisition of Sanders division, CalComp, a manufacturer of computer graphic terminals, plotters and digitizers.

One of Lockheed's biggest challenges in the future is retaining margins on its products. Problems with the C-5B aircraft program, coupled with public scrutiny into military contractors' "excesses" has made the company wary of retaining its technological edge under pricing pressure.

Motorola

11 Like other large semiconductor companies, Motorola Inc. struggled in 1986. But Motorola did manage a profit, posting pre-tax income of $265 million on $5.88 billion in revenue. Limited exposure to the memory business, along with substantial and successful diversification outside semiconductors, helped. Motorola also benefited from its broad product portfolio and market leadership positions in semiconductors. With everything from thyristors and zener diodes to 32-bit microprocessors and macrocell arrays chipping in, Motorola scratched out respectable semiconductor revenue growth of 9%. With the semiconductor business looking up, and with strong operations in mobile radio and cellular communications, Motorola is ready to roll. A bright first quarter saw pre-tax income rise by 29% compared with the first quarter 1986, while sales were up 10.5%.

Sales of communication equipment — which include two-way mobile radio systems — are leading the way. Orders for cellular radio gear are also sending out a clear signal, up 33% from a year ago. International sales, particularly in the Far East, have been another source of strength, growing 24% last year. Motorola's strong distribution network has been a key factor in booming Far East sales, according to Mona Eraiba, an analyst with Salomon Brothers Inc.

There are some weak spots. Motorola's computer systems business has been consistently in the red, says Edward C. White, analyst with E.F. Hutton. Earnings from government contracting have also been under pressure, according to White. But, with improved manufacturing efficiencies contributing to higher profitability in cellular radio, market leadership in 32-bit microprocessors, and broad strength in an improving semiconductor industry, Motorola should enjoy powerful momentum through 1987.

Honeywell

12 Honeywell Inc.'s revenue was $5.378 billion last year, up 7% from 1985.

Unfortunately for the balance sheet, Honeywell incurred major losses in 1986. Income from operations was down to $12.9 million, a drop of over 200%. The company suffered a major loss of $411 million from the disposal of Synertek Corp., which began in 1984, and the disposition of Honeywell's Information Systems (HIS) business, which will be completed in 1988.

Honeywell restructured in 1986, focusing on commercial aviation, military and space avionics, and ordnance and naval systems. The company has established a three-pronged approach toward restructure. Its business reorganized via cost cutting — Honeywell eliminated 3,200 jobs and several diversified ventures, including its Medical Electronics Division, Commercial Network Division, a commercial GaAs venture, Honeywell Ericsson

Development and Honeywell High-Tech Trading Co. Honeywell acquired Sperry Aerospace Group for a cool $1.029 billion to bulk up its presence in the commercial aviation market and to add to Honeywell's aerospace and military avionics business. It sold its Information Systems Group to Compagnie des Machines Bull of France and NEC Corp. of Japan, maintaining only a minority interest.

Texas Instruments

13 Last year was recovery year for Texas Instruments Inc. After losing $119 million in 1985, the company eked out a positive net income of $39.9 million on sales of $4.97 billion in 1986. But president and chief executive Jerry R. Junkins is not resting on his laurels just yet. In particular, he has two major long-term concerns: how to compete against the vertically integrated Far East corporations and how to smooth out the volatile, cyclical changes in the industry.

To answer both concerns, Junkins has a four-point plan: emphasize design automation and incorporate artificial intelligence (AI) into the technology; concentrate on manufacturing efficiency; target markets where TI can provide *system*-level solutions; and develop closer relationships with customers.

So far, Junkins' plan is working. For example, the company's new semiconductor fabrication facility built in Dallas has manufacturing yields comparable with the most skillful Japanese chip makers, according to Junkins. Better manufacturing prowess gives TI, with $1.9 billion in semiconductor sales last year, a chance at regaining the No. 1 spot in the industry after recently losing it to Japanese conglomerate NEC Corp.

Tighter customer relationships will also help. According to Junkins, TI has developed ship-to-stock programs with more than 50 leading electronic equipment companies. In addition to shutting out TI's competitors, these programs will also have a significant effect in moderating the volatility of TI's chip business. Such volatility has wreaked havoc with the company's finances in the past, such as in 1985 when TI's semiconductor sales fell 25% from the previous year.

NCR

14 NCR Corp. was proud that last year it moved away from the tradition of having the slowest growth in the computer business to a better-than-average 13% growth. The company is conservatively managed with an extremely sturdy balance sheet.

NCR is still holding true to its cash register origins. Point-of-sale and automatic teller machines are its strongest areas. The company brought out a new fault-tolerant host last year that kept compatible with its previous models, but it has not produced sales yet.

NCR is in the PC business, but has insulated itself from some of the volatility of that fickle market by selling into its customer bases in retail and finance. NCR's biggest challenges are its competitors. Tandem is hot, Stratus is teaming up with IBM, and the workstation companies are looking hungrily at NCR's markets.

Raytheon

15 Sales and net income in all Raytheon Co.'s divisions reached record levels in calendar 1986 and there is every expectation that the Lexington, Massachusetts-based company will not slow down in 1987. It is no secret that one of Raytheon's main strengths is its balance sheet. Net sales increased by 14% from $6.4 billion in 1985 to $7.3 billion in 1985, while net income rose by 4.6% from $375 million in 1986 to $393 million in 1986.

The electronics division, Raytheon's bread and butter, accounts for nearly 60% of sales, and defense electronics accounts for nearly 60% of all electronics. In all, over 53% of the company's sales are to the U.S. government. Even though defense spending has been capped, Raytheon's entrenched relationship with the DoD and the higher electronics content in all of the defense spending ensures the company will continue to profit from the federal government. Its main defense electronics products — the Patriot and Hawk missile systems — are highly profitable. This allows Raytheon a cushion as it gets more involved in the lower margin lines of second-sourcing defense contracts.

The other divisions of the company, including appliances, aviation, aerospace and energy services, also provide relatively stable sales growth for the company. One characteristic that differentiates Raytheon from its competition is its strong foreign defense business. Estimated at close to 17% of total sales, foreign-sourced revenue — including a $518 million extension to a Saudi Hawk contract — acts as a profitable insulation against potential domestic spending cuts.

Rockwell

16 Rockwell International, a respected player in the aerospace, electronics and automotive industries, has kept in stride for over a decade now. The $12.3 billion maker of the B-1B bomber and owner of industry automation specialist Allen-Bradley Co. posted its eleventh consecutive year of positive earnings growth in fiscal 1986, ended Sept. 30, 1986, with net income of $611 billion. But as the B-1 reaches the end of its production cycle next year and Congress puts a slowdown order on the space shuttle project, the uninterrupted growth may turn the company's stride to a slow walk by 1989.

To insure a smooth transition into the post-B-1 era, Rockwell is growing its $4.2 billion electronics business. Both telecommunications and avionics are prospering, but $1.07 billion Allen-Bradley — targeted for 20% annual growth by Rockwell back in 1985 — is looking pretty static as a result of cutbacks in corporate capital spending. The two other business segments, automotive and general industry, that together make up 20.5% of 1986 sales, are both healthy but do not offer the same kind of potential as electonics.

But, while some Rockwell watchers are forecasting a severe revenue drop-off by decade's end, a more optimistic contingent only sees a plateau or slight dip. The difference in opinion stems from how slow the slowdown in DoD business will be, whether the electronics recovery materializes, and if the national aerospace plane (NASP) ever gets off the ground. Nearly half of Rockwell's revenue is in aerospace and so the company's future is largely dependent upon the federal budget process. Without an explosive effort from AB, and electronics in general, Rockwell's hope of continued revenue growth looks unlikely.

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Eastman Kodak

17 Eastman Kodak Co. spent 1986 trimming its sails. Nearly 13,000 employees left the company through a reduction in force program. Many manufacturing facilities and a variety of divisions were consolidated, all in an effort to improve its revenue-to-cost ratio. By the end of the year, net earnings — at $374 million on total sales of $11.55 — were up 13%.

During the same year of cost reductions, the Rochester, New York-based company also introduced more than 100 new and improved products. Heavy spending in both research and development — $1 billion — and capital expansion — $1.4 billion — resulted in a variety of product introductions including new copiers, a high-volume nonimpact printer that uses light-emitting diode technology, information management systems and write-once and erasable optical discs.

Sales of electronic products reached $3.85 billion during 1986, and represent one-third of the company's total revenue. During 1987, the company will be leveraging its expertise in photography to sell a number of electronic products. One of its new product lines includes computers that use optical disc technology for the storage and retrieval of large amounts of data and images.

N.A. Philips

18 With the dissolution of U.S. Philips Trust, NV Philips of Eindhoven, Netherlands, now directly holds 58% of North American Philips. Despite the fact that the remaining 42% of N.A. Philips is publicly traded on the New York Stock Exchange, many observers expect that this transfer will result in greater control of N.A. Philips by its Dutch majority shareholders.

Philips' managers face the task of turning around a troubled business in consumer electronics. Over the last three years, those operations have cost the firm a total of $23.7 million. The loss in 1986 was $6.4 million on sales of $1.3 billion. The color television business, which includes the brand names of Magnavox, Philco and Sylvania, continued to run at a loss, according to Robert Gutenstein, director of research for the securities firm of Kalb, Voorhis and Co. Costly picture-tube development programs contributed to the deficit. And the giant consumer electronic "superstore" retailers have also hurt consumer electronics manufacturers with their hardball purchasing tactics, according to Gutenstein. Firming prices in color televisions, the result of a currency-related profit squeeze on Japanese manufacturers, could help to put consumer electronics in the black in 1987.

Electronic components did much better, producing operating income of $136.5 million on revenue of $892.6 million. Although Philips is a leader in sales of passive components, it is not always recognized as the company behind its products. The parent logo is often obscured behind those of Airpax, Dialight, Mepco/Centralab and Ohmite. The situation is much the same in consumer electronics where Magnavox, Philco and Sylvania, not Philips, are recognized. To build brand-name recognition, the company is expected to begin marketing some audio products under the Philips logo. Meanwhile, the New York City-based conglomerate will have to make do with transcontinental ownership, multiple brand names, products as diverse as power resistors and electric shavers — and a tidy $4.5 billion in revenue.

Tandy

19 Life at the low-end can be very lucrative. Just ask the folks down in Fort Worth, Texas, who have turned a pokey old cow town into the capital of personal computer (PC) clonedom. Tandy Corp.'s roots are in leather processing, but the only hides Tandy has been tanning of late are those of competitors in the home and small business PC markets. In 1986, Tandy passed AT&T, COMPAQ and Zenith to emerge as the leader in unit sales of IBM-compatible personal computers, according to International Data Corp. In the first quarter of 1987, sales of MS/DOS computers were up by a nifty 62% over 1986, according to the company.

Still, Tandy chairman John Roche knows that life at the low-end can also be treacherous. Taiwanese board makers, intent on earning their spurs in systems, are following the Koreans and the mail-order discounters into the PC clone bazaar. Meanwhile, the rate of growth in sales of the 7,000 U.S. Radio Shack outlets has slowed in recent months. No hot-box successor to video cassette recorders has yet been identified as consumer electronics' savior. And, even though Tandy has secured its flank with the acquisition of price-cutting superstore chains like Scott-McDuff and VideoConcepts, it is still vulnerable to powerful high-volume consumer electronics outlets in some areas of the country.

Although IBM's Personal System/2 should not hurt Tandy much in the small business and home-user sectors, Tandy's ambitious salesforce expansion to penetrate major business accounts will likely suffer. As IBM begins the arduous, but necessary, process of knitting together its personal computer and mainframe architectures, Tandy and other clones will find IBM's large corporate customers less responsive to sales pitches based on price.

TRW

20 Defense has been good to TRW. But a good chunk of the components business has not. Last year, TRW Inc. sold off its businesses in resistors, capacitors and transformers. It lost $100 million in sales but actually boosted profits from the sell-offs. TRW also bought four small service companies to boost its third-party service operations.

Meanwhile, the company is focusing on defense. Defense and space-related contracts are producing expertise in gallium arsenide, millimeter-wave and microwave communications, and the world's fastest digital signal processor. These and its VHSIC business could, if TRW plays its cards right, translate into a strong position in the commercial semiconductor world.

TRW is in good shape, even if defense spending shrinks, due to its electronics and satellite emphasis. SDI is also a no-lose situation with a potentially huge payoff.

Control Data

21 The good news has begun to trickle in. A first quarter profit, a debt rating upgrade, a break-even in peripherals, and a major disk drive contract from — of all people — Japan's Sony Corp. After a calamitous series of mishaps

and world-class financial losses, Control Data Corp. is flirting with success.

But it is not yet clear that this romance will be consummated. CDC did narrow its losses in 1986: but that was from roughly half a billion to roughly a quarter billion dollars. And even though some analysts foresee profitability for 1987, the company's long-range strategic direction is not yet in view.

In selling off both unproductive and unrelated businesses, CDC has focused on core enterprises in computer systems, peripherals and computer services. Data storage products, the company asserts, were slightly profitable in 1986. This is no mean accomplishment since, in 1985, they spun their way to $300 million in losses. Posting a profit, while revenue declined from $1.27 billion to $1.05 billion required trimming product portfolios, closing facilities and eliminating more than 9,000 jobs. But improvements in manufacturing processes have produced more reliable drives, and some analysts believe CDC has actually regained market share on some of its larger Winchesters. Two other positives for the company have have been its steadfast funding of R&D and the emergence of third-party maintenance as a lucrative growth business.

But the soul of CDC has always been in its computer business. Revenue in this sector declined by 5.9% to $1.3 billion in 1986. Worse yet, it is hard to identify an area of exciting growth or market leadership in CDC's computer business. Its investment in next-generation supercomputers through ETA Systems is not expected to be profitable until 1989. If the company is to expand beyond its traditional strength in the electric utility industry, and in such applications as weather forecasting and petroleum exploration, it will have to demonstrate broader systems capability. One belated step in that direction was the recent introduction of a departmental processor. Much more will be necessary, and it won't come cheap. By raising $530 million from the spinning off of Commercial Credit Co. and by raising over $350 million through a public debt offering and yet another $140 million from asset sales, CDC has at least bought itself some time to rewrite its future.

Wang

22 Before struggling back to profit in its third period, that ended March 31, Wang Laboratories Inc., with its two quarters of losses, had been one of the computer sector's poorest performers.

The challenge for new president Frederick Wang is figuring out how to stay in the black. Although the company expects solid profitability for the fourth quarter, second quarter write-downs will make fiscal 1987 a red-ink year.

Fred Wang is shooting for better: by the early 1990s, he wants Wang to be a $5 billion company making 10% after-tax profit and growing the company's revenue in key markets 20% annually. A tough cost-cutting program and new 7000-series computers are a start. "We have the products and the people — now it's time to perform," says a spokesman.

Litton

23 Litton Industries Inc. is in a holding pattern. The company's sales declined from $4.6 billion in fiscal 1985, ending July 31, 1985, to $4.52 in fiscal 1986, and net income dove from $299.5 million in 1985 to $71 million in 1986. As a result of general economic conditions, the first half of fiscal 1987 looks equally sour with both sales and net income down. It appears that Litton's focus on the automation market's factory of the future is not materializing as quickly or as profitably as it had hoped. But with some restructuring, Litton intends to be a $1 billion automation player by 1990.

To turn things around, Litton recently acquired Lamb Technicon, a privately owned, Detroit-based engineering systems company that will open new markets in factory automation, especially with the big auto makers. Also, because of the drop in oil prices, Litton spun off its resources group — an oil exploration operation — by entering into a joint venture with Dresser Industries Inc. The new venture, of which Litton controls 70%, is called Western Atlas International and allows synergies that both companies hope will lead to profits. Litton's military business remains strong with backlogs into 1992.

The rebound of Litton's sales and income will depend primarily on the health of the U.S. economy, on oil prices and the move toward factory automation. But with Litton's commitment to be one of the top four factory automation companies in the market, the message is clear: Litton is in for the long haul.

Westinghouse

24 Last year, Westinghouse Electric Corp. was probably pressed to find enough pens to sign all of the military contracts it won. Its challenge now: deciding which of many new opportunities to pursue, and how to form the teams to pursue them.

Defense electronics — radar especially — remains Westinghouse's high-tech high point. Sales and profits grew as it won avionics development awards with both Advanced Tactical Fighter prime contractor teams and was chosen to supply the radar for Britain's Airborne Warning and Control System (AWACS) planes.

Backed by an award-winning automated factory in Texas, Westinghouse has produced over 2,000 radar packages for the F-16 fighter; new orders promise $600 million more. The outlook for Westinghouse's military-electronics sales, defense downturns notwithstanding: up to 10% annual growth.

3M

25 3M Co.'s Electronic and Information Technologies Sector is projecting modest sales growth in 1987. The Electro-Telecommunications Group hopes to outpace the growth of the markets it serves by focusing on rapidly expanding product, notably telecommunications test equipment and fiber-optic connectors. Last year, 3M acquired Dorran Photonics Inc., a New Jersey manufacturer of fiber-optic connectors used in the telephone and datacommunication industries.

The Memory Technologies Group, meanwhile, expects to reduce operating losses this year and further increase earnings in the future. "Investments in more efficient production equipment are resulting in substantial cost reductions and are helping to cushion the impact of continued price

erosion," says Allan J. Huber, the sector's executive vice president. "Significant economies also are resulting from consolidation of video and data recording businesses into a single operating unit." This year, 3M will begin producing erasable optical media. Last year saw the start up of a new plant for prerecorded optical media.

The sector's Information Systems Group is optimistic about future growth in the face of the demand for improving productivity in the office. New electronic systems for document storage and retrieval were introduced last year. And Harris/3M Document Products Inc., a joint venture with Harris Corp. for copiers and facsimile machines, completes its first year of operation. In 1986, 3M's electronics revenue climbed to $2.46 billion from $2.272 billion the previous year.

Ford

26 Ford Motor Co. is optimistic that the trend toward increased electronics in automobiles will continue. The company's Electrical and Electronics Division (EED) is investing $94 million to make new-generation alternators and $78 million to make starters. At Ford Microelectronics Inc., large-scale integrated circuits are tested to guarantee top-quality engine-control devices.

In 1986, Ford Aerospace & Communications Corp., meanwhile, achieved contracts worth a record $1.7 billion, up 29% from the previous year. Ford Aerospace makes tactical weapons systems, advanced space systems and C^3I (command, control, communications and intelligence) systems. Eleven Ford Intelsat V satellites transmit two-thirds of all overseas communications, according to the company.

Last year, Ford's electronics revenue climbed to $2.423 billion from $2.071 billion in 1985. A primary concern at Ford is, of course, the lopsided balance of trade with Japan and increasing competition from South Korea and Taiwan. Ford sees cost cutting and productivity improvements as key challenges and is spending heavily to expand computer-aided design and manufacturing operations throughout the company.

ITT

27 ITT has been churning with change. Last December the company spun off its worldwide telecommunications equipment manufacturing operations into a joint venture with Compagnie Générale d'Electricité (CGS) of France. CGS is running the joint venture, named Alcatel N.V.; ITT retains just a minority 37% ownership.

So ITT, once a powerhouse in the market, has called it quits in telecommunications. Although the company still has a $1.7 billion stake in the industry, it is basically a passive investor. The joint venture with CGS follows ITT's much-publicized failure to develop a competitive digital telephone switch. After spending a reported $1 billion over 10 years, ITT produced the System 12, a product that U.S. customers shunned. In fact, the System 12 was so unpopular that last year ITT withdrew from the U.S. switching market altogether.

The company's telecommunications operations is one of the latest casualties in ITT's bid to divest itself of certain businesses. Since 1979, ITT has sold more than 100 of its companies and the employee ranks have correspondingly fallen from a staff of 369,000 to just a third of that last year. Chairman and chief executive Rand V. Araskog says that the leaner ITT will better be able to concentrate on more strategic businesses. (Through the joint venture with CGS, ITT received $1.3 billion from which the company knocked off $750 million of debt from its balance sheet.) More than half of ITT's 1986 revenue of $17.4 billion came from the company's insurance and financial services operations. Of the remainder, ITT's major businesses include automotive parts, defense and space products, electronic components and pumps, among other diversified products.

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Many Wall Street analysts speculate that ITT is not yet done divesting. Up for sale soon, some say, could be the company's paper products business and Sheraton hotel chain.

Martin Marietta

28 Facing increased competition and more restrictive government budgets, Martin Marietta Corp. is focusing its expansion on systems with high electronics content. It has, to a large extent, become a defense electronics supplier, with 40% of all 1986 defense sales derived from that source, according to the company. Such revenue has more than doubled in the past three years and will continue to climb over the next few years.

In 1986, Martin Marietta's electronics revenue rose to about $2.16 billion from $1.882 billion the previous year. "Our belief is that the growth of defense electronics will outpace the growth rate of the total defense market," say Thomas G. Pownall, chairman and chief executive, and Norman R. Augustine, president and chief operating officer, in the company's 1986 annual report. Martin Marietta is in the aerospace, defense electronics and information systems businesses, as well as energy and materials.

Martin Marietta hopes to avoid cyclical downturns by maintaining a diversified portfolio. Its 10 largest programs account for about half of total sales. The largest is less than 10% of total sales. With this in mind, the outlook for 1987 and beyond in positive, although growth will vary from industry to industry. The information systems business, for example, is expected to expand rapidly. With cutbacks in Defense Department and NASA budgets, however, aerospace growth will slow. Nonetheless, although the grounding of the Space Shuttle has resulted in order delays, it — along with new government space policies — has also expanded the market for expendable launch vehicles. The Air Force, for example, has increased orders for the Titan family of launch vehicles. And Martin Marietta also is offering a commercial version of the Titan to take advantage of the backlog of communications satellites needing transportation into space.

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Harris

29 To combat sluggish demand in Harris Corp.'s three key markets — information systems, communications and semiconductors — president John Hartley last year went back to basics with a streamlining plan that smartens up manufacturing, boosts quality and weeds out slack product lines such as cellular phones and programmable read-only memory chips.

He must be doing something right. Earnings for fiscal 1987's first three quarters are headed north: up 24%, 38% and 43% respectively on 1986. The third quarter showed sales gains and returns to profit in information systems and semiconductors.

But Hartley is far from ecstatic. Lacking firm market upswing, Harris needs more marketing polish and name recognition in commercial markets so sales and profit gains won't lose momentum.

Grumman

30 Grumman Corp.'s revenue for fiscal year 1986 was $3.502 billion, up 12% from 1985, although net income of $78.7 million was down 3% from 1985 figures. And its 1986 electronics sales, which made up 14% of Grumman's overall sales, doubled to $2.075 billion from 1985's $1.128 billion.

The company opened a new plant in Salisbury, Md., for electronics systems manufacturing and began work on a plant in Benton, Pa. The company was the third largest recipient of the Department of Defense's prime contractors for research, development, test and evaluation awards for fiscal year 1986, receiving $910 million; and it was the 10th largest recipient of overall contract awards from the Department of Defense, drawing in $2.967 billion.

Grumman's reaction to increased congessional pressure to tighten up procurement expenditure is evident in its efforts to cut costs. The company relocated nonmilitary space operations from Long Island, N.Y., to Houston, and opened a Joint STARS (Surveillance Target Attack Radar System) facility in Melbourne, Fla., citing lower cost of living rates and better competitive pricing margins for engineering talent as reasons for the move. Grumman also spent $191 million on capital equipment in 1986 in order to modernize facilities as a result of increased governmental pressures to upgrade manufacturing facilities and decrease fiscal waste.

Apple

31 After a tumultuous year in 1985, when Apple Computer Inc. jettisoned the last of its founding fathers, the company concentrated on controlling costs, with annual sales remaining in the $2 billion range.

Although the company began the year by introducing the Macintosh Plus — which gave Apple its first real inroad into the Fortune 2000 market — and followed with the Apple IIgs in September, the company's most important efforts might have been in positioning itself for a transformation toward higher-end systems in 1987.

Under a new division responsible for the company's strategic development, Apple purchased hardware developer and Unix systems house Cadmus in the summer of 1986 and created a venture capital fund. Those strategic decisions paid off in early 1987, when the company introduced the OpenMac, a Macintosh with six slots and a dedicated Unix microprocessor option designed to leverage Apple into the value-added reseller market. The company also made its first investment in a software developer, Forethought Inc.

GTE

32 Telecommunications titan GTE Corp. will be happier when it stops losing money on the U.S. Sprint long-distance network it owns half of. Otherwise, it has few complaints about 1986, a year of record sales and net income.

Communications products — GTE's main electronics unit — showed higher income as margins improved on consumer items such as telephones. Government systems are enjoying steady revenue increases, thanks largely to a whopping $4.3 billion Army battlefield-communications award.

Now, 1987 will show whether GTE can sell its GTD-5 digital switch to those most discerning customers: the Bell operating companies. And it will prove whether GTE was right to form recent joint ventures with Siemens AG on its international transmission systems and public-switching operations, and with Fujitsu America Inc. on business-communications systems for U.S. markets.

Boeing

33 The Boeing Co. anticipates reduced sales in 1987 and continued pressures on profit margins in both commercial and government programs. In 1986, electronics revenue increased to $1.975 billion from $1.85 billion the previous year. Government budgetary constraints and procurement policy changes will mean fewer new program starts, increased competition and tougher accounting practices.

Still, Boeing is optimistic that it can offset these pressures by cutting costs and improving productivity. Strategic alliances, for example, will help reduce the cost of expensive computing and electronics programs. An agreement with Honeywell calls for that firm to supply Boeing access to very high speed integrated circuit technology for specialized applications. And Boeing agreed to market and supply operating software for Scientific Computer Systems' SCS-40 near-supercomputer.

In 1986, Boeing received a number of plum contracts. After intense competition, the Boeing E-3 AWACS was chosen as Britain's airborne early warning system, extending the life of this program. Boeing was awarded full-scale development funding for the V-22 tilt-rotor aircraft, Sea Lance missile, Hard Mobile Launcher and Short Range Attack Missile II. It also gained a key role on one of two teams selected to develop prototypes of the Advanced Tactical Fighter. "1986 was a rewarding year for the company, and the long-term outlook is positive," says T.A. Wilson, chairman.

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Zenith

34 Last year, Zenith Electronic Corp.'s sales bounced back up, to $1.89 billion, after slumping in 1985. Still, the company faced its second straight yearly loss, amounting to $20 million before taxes. Those who live by the VCR, die by it. Higher volume sales were offset by shrinking prices, and Korean and Taiwanese television pricing — Zenith calls it "dumping" — hurt as well.

To combat consumer pricing, Zenith switched over to a new, surface-mount technology chassis for its color TVs. That hurt margins last year, but should cut costs in 1987. Likewise, a new line of flat tension-mask picture tubes and monitors, with $20 million in capital behind it, will start showing up in Zenith computers this year and in TV sets in 1988.

Computer sales were up 56%, to $548 million, and Zenith won two choice government contracts. The much-publicized IRS lap-top computer deal should be worth $27 million, but a three-year, $242 million military contract will initially be a low-margin exercise.

Eaton

35 During 1986, Eaton Corp. played to its strengths. The company, founded in 1911 as a manufacturer of truck axles, had diversified into a number of areas over the years, some of which had ceased to be profitable. So last year the company retrenched, focusing its energies on its major business areas: the controls operations market, including automotive and electrical controls and equipment; the defense industry; and the automotive and truck power train market.

As a result, the company plans to sell its Eaton-Kenway division, which serves the automated materials handling market, and the Industrial Polymer division. Eaton has also exited the microwave test market and liquidated several product lines in its semiconductor equipment operations.

Supporting its new strategy, Eaton acquired the Singer Company's controls division in June 1986 (sales in 1985 were $106 million), which produces electronic and electromechanical control devices primarily for automotive and appliance manufacturers. Also acquired last year was Consolidated Controls Corp. from Farley Industries, which had $106 million in sales in 1986. Consolidated Controls manufactures switches, actuators and power control systems for the aerospace/defense industries. Eaton also purchased American Nucleonics Corp., a manufacturer of advanced microwave systems and antennae.

Known in the financial community for astute financial leadership, Eaton is in the enviable position of having 73% of its products be in either the No. 1 or No. 2 spot in market share during 1986.

Pitney Bowes

36 As the worldwide leader in postage meters, and mailing and shipping systems, Pitney Bowes Inc. of Stamford, Conn., enjoyed another prosperous year of steady growth in 1986. Its revenue of $1.99 billion was up 9% over 1985, reflecting a higher increase than any in recent years. Meanwhile, net income grew by 17% to $166 million.

Chairman and president George B. Harvey expects growth this year will be even stronger. According to him, Pitney Bowes sales will grow at least as fast as they did last year. He explains that his company introduced more than 50 new products last year and those products will, this year, have the benefit of a full 12-month revenue flow. Also, Pitney Bowes is introducing another high level of new products in 1987.

While the company has maintained its leadership in mailing and shipping systems, which accounts for more than half of total revenue, it has also begun to prosper in other markets as well. In particular, sales of Pitney Bowes facsimile machines grew by 77% last year. The company claims a leading position in Great Britain and West Germany and says it is the No. 1 supplier of new facsimile units in Canada. In addition, Pitney Bowes is also prospering in the Dictaphone and voice-processing system market. This sector's 1986 revenue of $235 million was up 15% over 1985. And furthermore, the company's financial services group logged a 16% increase in net income last year. This group claims a portfolio with 1986 year-end gross financial assets of $2.2 billion, up 27% from 1985.

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Du Pont

37 For a chemical company, $1.7 billion in electronics sales isn't bad. But E. I. du Pont de Nemours & Co. is looking for more than that. After creating a new Electronics Department in October last year, the company hopes to up its electronics sales and reach $2.5 billion by early next decade.

To do that, the Wilmington, Del., company plans to invest $135 million this year in electronics research and development and forge, through acquisitions and joint ventures, into new markets. Primarily a maker of electronics materials and connectors, Du Pont is aggressively moving into optoelectronics and information storage. Last year alone the company entered into an optical-disc technology joint venture with N.V. Philips and acquired three firms, including Tau Laboratories Inc., a maker of photomask products for the semiconductor industry.

Du Pont's challenge this year is to manage all of these activities, particularly in new markets where the company faces formidable, more seasoned competitors.

McDonnell Douglas

38 McDonnell Douglas Corp. last year had $12.6 billion in total revenue. But things may get tougher for this major defense contractor whose electronics-only revenue for 1986 totaled $1.7 billion. U.S. government procurement practices are going through some changes that will increase competition among government contractors and will press even harder on corporate bottom lines.

As if anticipating these times, McDonnell Douglas several years ago ventured into the communications business with dreams of generating a

high level of earnings based on multi-billion-dollar revenue. Instead, the Information Systems Group (ISG) has continued to rack up losses for four consecutive years, including a $69.7 million loss based on 1986 revenue of $1.19 billion. The challenge for ISG in 1987 will be to break even.

Across the board, McDonnell Douglas is faced with the task of improving productivity in order to increase profits. The company also hopes to win an increasing number of government contracts.

National Semiconductor

39 The good news regarding National Semiconductor Corp.'s 1986 financial performance is that revenue was up 4.5% to $1.678 billion. The bad news is that losses — which totaled $57 million — continued to plague the bottom line.

While struggling with the residual effects of a dramatic industry downturn, National upped its allotted research and development expenditures to approximately 15% of total revenue. This spending was focused on the development of high-density CMOS, MOS and VLSI technologies and products, as well as on point-of-sale terminals and systems.

National is looking to both internal and external forces to improve its performance in 1987. In addition to shipping a number of new products this year, the Santa Clara, California-headquartered company is changing some marketing strategies including expanding its distribution base and creating a direct sales group in the United States for its Semiconductor Group. At the same time, the overall business climate is gradually improving, which should have a positive effect on 1987 financial results.

AMP

40 Last year the world's No. 1 connector maker, AMP Inc., was recovering from a sluggish 1985 during which sales declined 10%. Throughout 1986 the Harrisburg, Pennsylvania-based manufacturer had to walk a fine line — cutting costs and boosting profitability, while preserving its technology, sales and manufacturing bases in order to be prepared for the inevitable industry upturn.

The numbers indicate that AMP — whose total 1986 revenue rose to $1.9 billion — is emerging generally unscathed. Earnings have inched up to 8.5% of sales and last year's electronics revenue of $1.6 billion represented an increase of 18%. Today, analysts estimate that the company's U.S. plants are running at roughly 70% capacity, which leaves AMP with the continued challenge of increasing capacity and containing costs.

The 1987 game plan calls for more streamlining of U.S. operations, while expanding international sales and manufacturing bases in the Far East, Europe and South America. In addition, AMP is looking to broaden its product offerings. One new market focus is networking and customer premises wiring. And, last year's acquisitions of Fiber Optics Communication Specialists (FOCS) and Lytel Inc. will enhance AMP's interests in electro-optics.

Singer

41 In 1986 The Singer Company completed its six-year business plan of shedding its slow-growth commercial operations and repositioning itself as an aerospace/electronics firm. Consequently, the company that has a name synonymous with sewing machines spun off that operation as well as its furniture business.

In addition, the Stamford, Connecticut-based company — which generated $1.48 billion in electronics revenue last year — sold its Controls Division in order to fund two strategically important acquisitions. The Dalmo Victor Division of Textron Inc., a manufacturer of radar warning systems, cost Singer $174 million. No price was disclosed for the purchase of privately held Allen Corporation of America, a developer of defense-related training programs and related equipment.

Now that the corporate reorganization is complete, Singer is free to concentrate on the further development of existing lines of business with particular attention being paid to its government products, which accounted for $1.43 billion, or 83% of last year's total revenue.

United Technologies

42 On the heels of a major restructuring, United Technologies Corp. is projecting growth this year in its core electronics-related businesses — aerospace, defense and automotive. In 1986, United Technologies electronics revenue fell to $1.413 billion from $1.877 billion the previous year. "The disappointing results for 1986 confirmed the necessity of the restructuring actions we have taken and left us more confident than ever of the basic strengths and future prospects of United Technologies," says Robert Daniell, chairman and chief executive.

As part of its housecleaning of the past two years, United Technologies has disposed of its Mostek semiconductor business and sold its telecommunications operations. Company-wide, in 1986, strong earnings performance at Pratt & Whitney (engines) and UT Automotive and Carrier (building group) somewhat offset the effects of operating difficulties at Hamilton Standard (controls) and Norden Systems (radar).

United Technologies' optimism is based at least in part on groundwork laid in 1986. Norden reorganized its advanced radar programs following a $155 million write-off due to anticipated losses on contracts in this area. Hamilton Standard won seven development contracts relating to the space station. United Technologies Microelectronics Center (UTMC) was certified by the Defense Electronics Supply Center, improving its competitive position in aerospace and military markets. And Sikorsky rolled out its new X-Wing Rotor Systems Research Aircraft which takes off and lands vertically.

Teledyne

43 At Teledyne Inc., sales were up last year, but operating results were down. Management blames the decrease in Teledyne's $1.4 billion Aviation and Electronics segment on higher expenses and lower margins in government R&D contracts. Teledyne's industrial sector electronics suffered as Big Oil stopped buying.

Thirty percent of Teledyne's myriad businesses depend on the government,

and much of that is defense oriented. Thus, the continuing stagnation of the defense budget worries Teledyne, even as the electronics content of weapons goes up.

Tektronix

44 Tektronix Inc.'s 1986 sales were down in instruments, communications and graphics. So far this year, however, things are looking up. Sales are up slightly, and profits are up 60% for the first nine months.

A couple of years ago, under intense pressure from Japan, Tek set out to make itself a world-class manufacturer. Now the company is a leader in just-in-time, and other manufacturing and inventory techniques, resulting in seven inventory turns per year.

Tek must establish itself in the computer-aided engineering business, or risk losing hold of its instrument customers. Its 2-year-old, $75 million acquisition of CAE Systems has yet to yield big results, however. But a new line of graphics terminals and oscilloscopes show that Tek can still match or better the competition in its core businesses.

Emerson Electric

45 Emerson Electric Co. has built a reputation for itself as a broad-range supplier of electronic products. Today, however, the $5 billion company is being squeezed by an onslaught of foreign competition. During 1986, imports rose 14% in the markets where Emerson competes.

Although some economists predict that the import intrusion will level off in 1987, Emerson is not counting on it. Instead, the St. Louis, Missouri-based company will continue its plans of consolidating U.S. manufacturing operations, while expanding both product lines and international markets.

Also included in Emerson's expansion plans is a desire to increase its interest in electronics, which last year accounted for $1.3 billion or 25% of total revenue. The company's most recent acquisitions in this area include Copeland Corp., purchased for $541 million; Hazeltine Corp., purchased for approximately $189 million; and Liebert Corp., purchased for roughly $516 million.

Data General

46 Although revenue was up in 1986, net income was down, way down: Data General Corp. had a net loss of $28.9 million in 1986. The company suffered an extraordinary loss of $34.7 million, which resulted from the settlement of litigation between Data General and Fairchild Semiconductor Corp. and the after-tax charge from the early redemption of the company's $75 million 13% Sinking Fund Debenture, due in 2005. Data General's income from opera-

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tions is only $20.7 million, down 42% from 1985 and down nearly 500% from 1984.

In efforts to realign itself to remain competitive in the marketplace, Data General has restructured its corporate organization into two areas. The Information Systems Group focuses on high-growth market segments; the Communications Systems Group focuses on networking, datacommunications products and future services. The company discontinued volume manufacturing of semiconductors at their Sunnyvale, Calif., plant because small-volume manufacture at the facility was noncompetitive. Facilities were also closed in Austin, Texas, and Hong Kong. The company has shifted its personnel from administration and manufacturing to sales, systems engineering and product development. Even with these changes, Data General was forced to cut its staff from 16,535 to 15,565 employees, a reduction of 970 people.

Since Data General established its Communications Systems Group, the firm has purchased several ventures in efforts to break into the datacommunications and network markets. DG acquired an integrated digital network operation from United Telecommunications Corp.

Avnet

47

As the top-ranked industrial distributor in the world, Avnet Inc. is in a league of its own. But just because it is twice the size of its nearest competitor, Avnet is not immune to the protracted electronics industry downturn. The New York City-based company's sales have been slipping for the last three years, from a record 1.6 billion in fiscal 1984, ending June 30, 1984, to $1.4 billion in fiscal year 1986. Avnet's earnings have also declined from $86.8 million in 1984 to $23.9 in 1986. And sales for the first six months of fiscal 1987 were up, as net income continues its decline.

This deteriorating financial position is partly the result of overproduction, overstocking and a continuing dismal demand for electronic components, particularly semiconductors. But Avnet is fighting back with entry into new markets and some internal structural change: these include application-specific integrated circuit (ASIC) design centers; more of a focus on computer systems; strategic alliances with a number of companies; a restructuring of the company's branch network; and a commodity franchise between Time Electronics, a member of Avnet's Electronic Marketing Group, and Motorola Inc.

Avnet's recovery is inextricably tied to the electronics industry recovery. Signs are appearing, indicating that business is on the mend: book-to-bill ratios are improving, inventories are being whittled down, and prices are firming. There is little chance that growth rates of the magnitude experienced in 1983 and 1984 will happen again soon, but Avnet will continue to dominate distribution.

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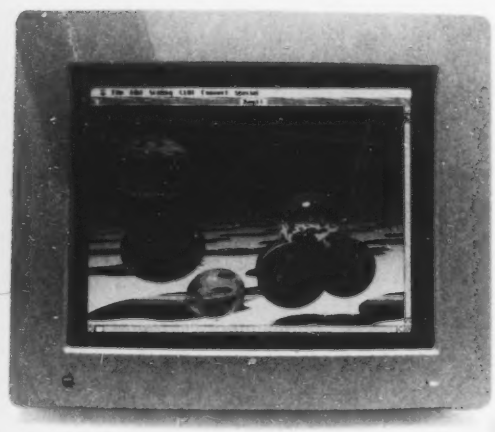

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Intel

48 In Intel Corp.'s 1986 annual report, chairman Gordon E. Moore and chief executive Andrew S. Grove began the document with a terse statement: "We're pleased to report 1986 is over." Indeed, since 1985 when the current semiconductor recession began, Intel has closed eight of its plants, reduced its workforce by 7,200 employees and lost more than $170 million.

But things have been picking up recently at the Santa Clara, California-based semiconductor manufacturer. After operating income losses of $195 million last year and $60 million in 1985, the company now appears ready to breeze back into the black. For the first quarter of this year, Intel reported a net income of $25.5 million on sales of $395 million.

The company said the good news was due, in part, to an increase in demand by customers in the personal computer industry. In fact, the company has said that it might sell as many as 4 million of its 80286 microprocessors this year, about double the approximately 2 million the company sold in 1986. The 80286 is used as the brains of many personal computers, the IBM PC AT chief among them.

Furthermore, Intel is counting on strong sales of its new 80386 chip, successor to the 80286. The company predicts it might sell as many as 1 million 80386 chips this year. Intel's boasts are not without substance. IBM announced last spring that it would use the 80386 in the next generation of Big Blue personal computers. But the sailing has not been all smooth for Intel. A recently discovered obscure malfunction in the 80386 has forced the company to recall some of the chips. The company took a special charge against earnings in the first quarter this year in anticipation of replacing the defective chips.

Northrop

49 Northrop Corp. had revenue of $5.608 billion in 1986, up from 1985 revenue of $5.056 billion. Net income dropped sharply from the year earlier, coming in at $41.2 million for 1986; 1985 net income was $214.4 million. Electronics sales, which are 22% of total revenue, were $1.248 billion for 1986.

The company ranked 31st overall for the top 100 companies and subsidiaries according to net value of prime contract awards for the U.S. Department of Defense, with $742 million awarded in 1986, and also 31st in DoD prime contract awards for research, development, test and evaluation, totaling $160 million.

Research and development spending increased to $70 million, up from 1985's $30 million, as a reaction to governmental reductions in defense contractors' profit margins and transferal to private industry of some financial responsibility for new weapon development. Northrop claims that the increased spending in R&D cut sharply into earnings for 1986, noting

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that R&D programs usually produce lower margins than those in production. Northrop also says that classified programs are growing in number, scope and as a proportion of Northrop's total business.

Perkin-Elmer

50 A combination of diversified product groups and an adherence to strict cost controls helped to keep $1.3 billion Perkin-Elmer Corp. profitable in a year when many of its major markets were sluggish at best. Indeed, the company's 1986 electronics sales, the majority of Perkin-Elmer's revenue, only fell 3% to $1.18 billion.

During a semiconductor industry downturn that stopped many companies dead in their tracks, Perkin-Elmer's Semiconductor Equipment Group managed to stay profitable despite suffering a 26% decline in sales during its 1986 fiscal year, which ended July 31. New products and a joint venture with Citizen Watch Co. of Japan are expected to keep this group afloat despite continuing adverse market conditions.

However, within the intensely competitive superminicomputer market, the company's Concurrent Computer Corp. spin-off needs to put the brakes on declining revenue. And for the Optical Group, the firm would like to attract more government contracts, particularly in the areas of defense and space. The company's joint venture with the Cetus Corp. is also expected to enhance the Instrument Group's performance, especially in the biotechnology market.

E-Systems

51 In 1986, Dallas-based E-Systems Inc. became a member of the billion dollar club by posting sales for the calendar year of $1.145 billion, up from $926 million in 1985. But the 15-year-old electronic warfare and defense communications company is not ready to stop at its first billion. If John Dixon, chairman and recently retired chief executive of E-Systems, gets his way, E-Systems will reach $2 billion by 1990. Company watchers are confident that he can be held to his word and are optimistic that the new chief executive, David Tacke, is a capable successor.

By pursuing a strategy of "focused expansion," as Dixon calls it, the financially sound company is looking to move into new markets and to become a prime systems integrator. To this end, the company is looking to establish joint ventures and acquisitions and to become more involved in the highly competitive international defense electronics arena through affiliations with foreign companies. E-Systems management is also aware that to reach $2 billion by 1990, it must optimize its resources and take advantages of economies of scale. Through organizational restructuring, management is addressing the efficiency issue. □

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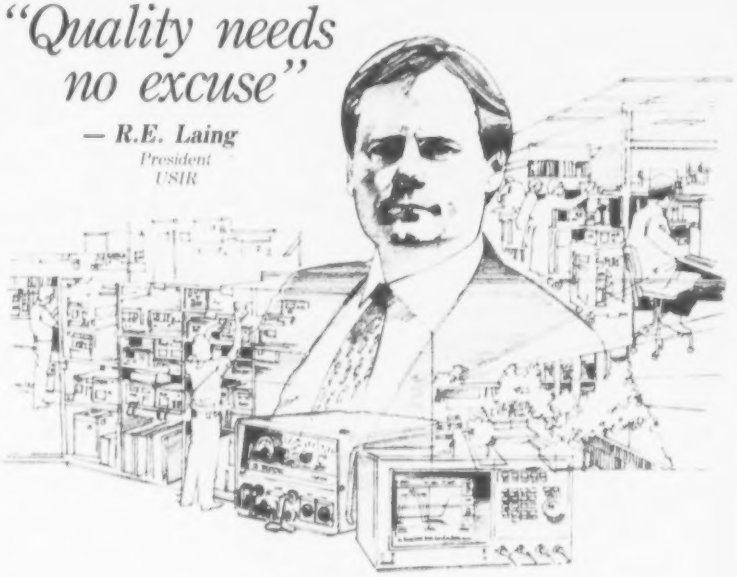

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